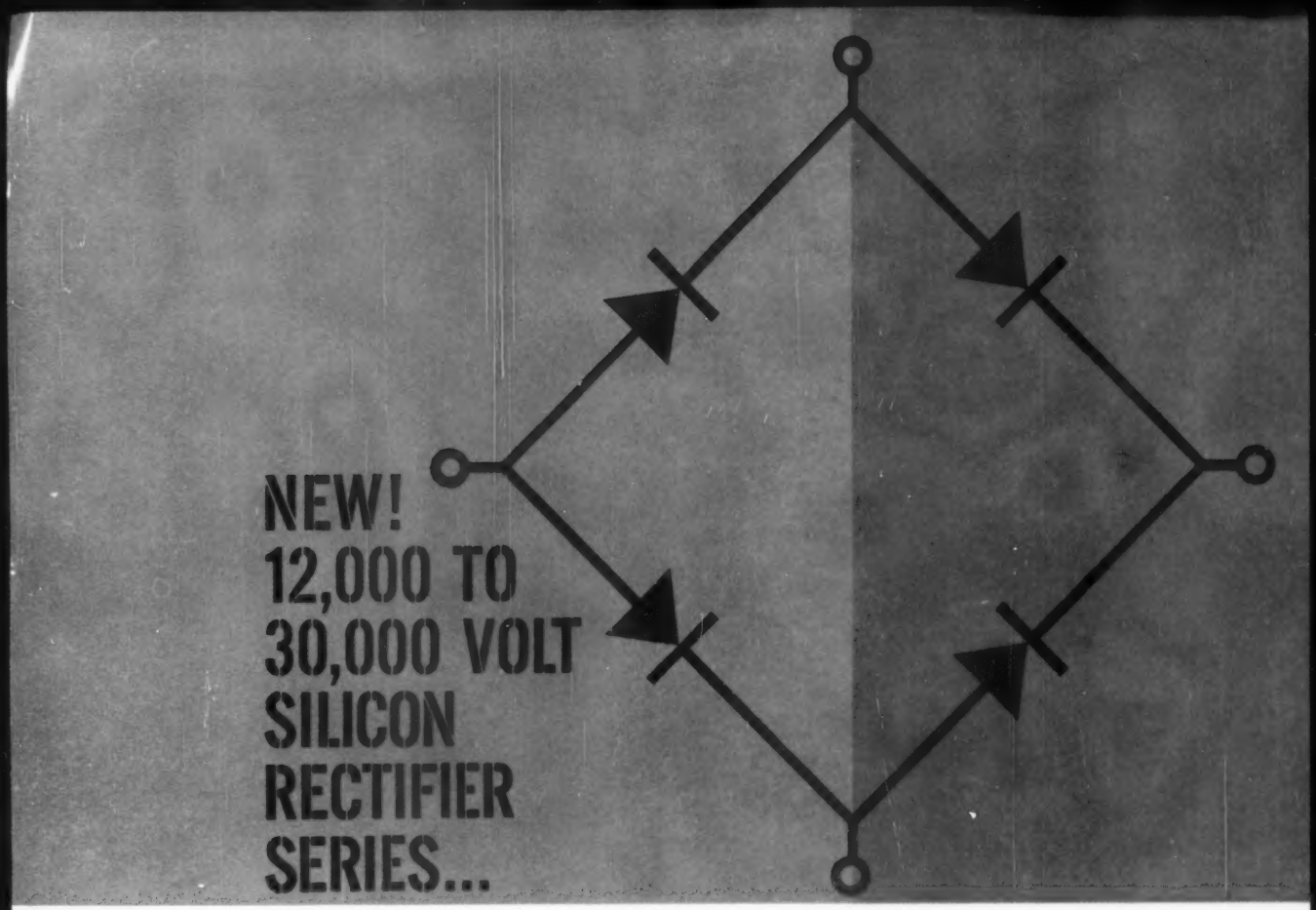
June 27, 1960

Aviation Week and Space Technology

SPECIAL REPORT:

Rocketdyne H-1 Saturn Engines



NEW! 12,000 TO 30,000 VOLT SILICON RECTIFIER SERIES...

with no voltage derating over entire range −55°C to 175°C!. .

Ten new Very High Voltage silicon cartridge rectifiers rated from 12,000 to 30,000 volts are now available in production quantities from P S I.

Designated 1N3052 through 1N3061, the new units are added to the existing P S I line to provide 19 EIA types with voltages ranging from 1,000 to 30,000 volts.

NOTE THESE OTHER FEATURES:

1—Easy to mount, compact, light weight
2—Non-metallic electrically "cold" case
3—All welded construction
4—Meet all applicable MIL specs
5—*Lowest voltage drop—highest current ratings—best reverse leakage characteristics of any available types*

This new series is ideally suited to radar modulator and power supply applications.

Like the widely accepted 1N1730 series (1,000 to 5,000 volts) and the 1N2382 rectifier series (4,000 to 10,000 volts) the new types are of special significance where light weight, unusual ruggedness and high reliability are of prime importance.

PSI

Write or wire for detailed specifications, prices and delivery schedules. NEW CONDENSED PSI CATALOG ALSO NOW AVAILABLE!

ELECTRICAL SPECIFICATIONS

MAXIMUM RATINGS

TYPE NUMBER	PEAK AND CONTINUOUS INVERSE DC VOLTAGE −55°C to +175°C (Vdc)	EQUIVALENT RMS VOLTAGE (Vdc)	FORWARD DROP AT 100 mAdc AT 25°C (Vdc)	AVERAGE RECTIFIED CURRENT (mAdc) 25°C
1N3052	12,000	8,460	70	100
1N3053	14,000	9,900	75	100
1N3054	16,000	11,300	80	100
1N3055	18,000	12,700	85	100
1N3056	20,000	14,150	90	100
1N3057	22,000	15,500	95	100
1N3058	24,000	17,000	100	100
1N3059	26,000	18,380	105	100
1N3060	28,000	19,750	110	100
1N3061	30,000	21,150	115	100

*Half Sine Wave, Resistive or Inductive Load. For higher Ambient Temperature derate average rectified current linearly to zero at 175°C.

OTHER SPECIFICATIONS

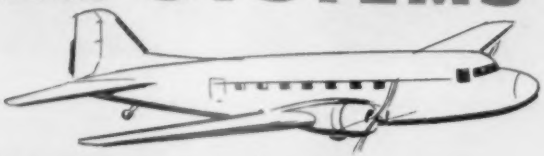
1. Inverse Current at Rated Inverse Voltage: 10 μA Max at 25°C and 100 μA Max at 100°C.
2. Maximum Non-Recurrent Surge Current: .008 second, 2.5 Amps at 100°C
3. Operating Temperature Range: −65°C to +175°C.

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.
12955 CHADRON AVENUE, HAWTHORNE, CALIFORNIA

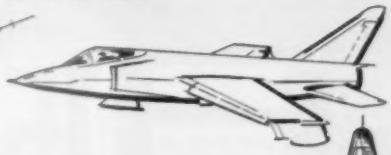
VICKERS®

FLUID POWER SYSTEMS

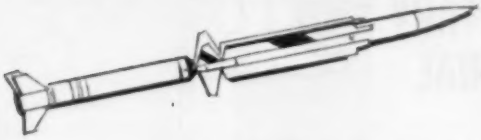


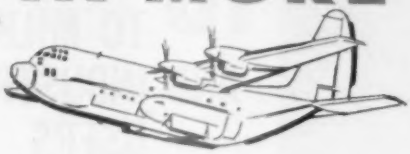
ARE ON MORE

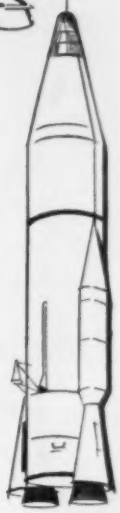
AIRCRAFT AND



MISSILES IN MORE







APPLICATIONS

THAN ALL OTHER

8791

MAKES COMBINED

Shown above is partial list of Vickers Aircraft and Missile applications.

AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

division of
SPERRY RAND CORPORATION

BENDIX OFFERS AN

EXCITING NEW EQUATION

IN CONNECTORS

MIL-C-26482

+

MIL-C-26636

=

15 VITAL ADVANTAGES TO MILITARY AND INDUSTRIAL USERS

Bendix

PYGMY®

ELECTRICAL CONNECTORS

MIL-C-26482 Type Connector

1. Industry acceptance.
2. Readily available.
3. Millions in use.
4. Extensive user service experience.
5. Satisfies 95% of all connector applications.

MIL-C-26636 Type Contact

6. Use MIL-approved crimp tools.
7. Positive reliability.
8. Maintenance and design flexibility.
9. Easily adapted to automated production.
10. Standardized user production tooling.

MIL-C-26482 and MIL-C-26636

11. No system redesign.
12. Big savings from adaptability to present equipment.
13. Automatic phase-in.
14. Solder option.
15. Competitive pricing.

Interchangeability, reliability, and availability are yours at minimum cost with this new, simplified Bendix Connector Combination. Check into it. We're sure you'll find profitable use for this latest development in our continuing program to provide both military and industrial users with the latest and best in electrical connectors.

Scintilla Division

SIDNEY, NEW YORK

THE Bendix CORPORATION

AVIATION CALENDAR

July 5-15—Special Summer Program in Inertial Guidance—Terrestrial and Interplanetary, Massachusetts Institute of Technology, Cambridge, Mass.

July 11-12—Conference on Response of Metals to High Velocity Deformation, Stanley Hotel, Estes Park, Colo. Sponsor: Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

July 18-19—Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio.

July 18-19—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Beverly Wilshire Hotel, Beverly Hills, Calif.

July 28-29—Seventh Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 1-3—"Future of Manned Military Aircraft" (Classified Meeting), Institute of the Aeronautical Sciences, El Cortez Hotel, San Diego, Calif.

Aug. 2-11—27th Annual U. S. National Soaring Championships, Ector County Airport, Odessa, Tex.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 16-18—Fourth Annual Tri-Service Conference on Biological Effects of Microwave Radiation, New York University Post-Graduate Medical School, NYU

(Continued on page 6)

AVIATION WEEK and Space Technology

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Vol. 72, No. 26

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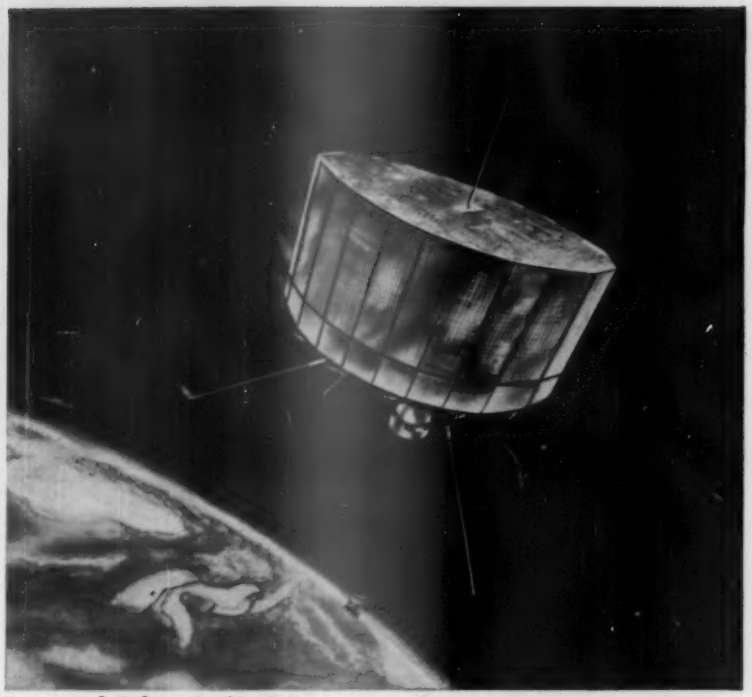


Photo courtesy Radio Corporation of America

aerospace

Components for RVX and TIROS Projects by LAVELLE

Major successes in the nation's accelerated space vehicle and missile programs include precision sheet metal components made by Lavelle. Among these is the fabrication by Lavelle of the structure of the new U. S. earth-circling TIROS weather observation satellite produced for the National Aeronautics and Space Administration by the Astro-Electronics Products Division, RCA. An artist's view of TIROS in orbit is shown above.

Photo courtesy World Wide Photos, Inc.

Pictured also is the recovery of the first successful RVX series re-entry vehicle after ICBM range flight. The aluminum alloy nose cone structure for this test was fabricated by Lavelle under sub-contract from the General Electric Company's Missile and Space Vehicle Department.

Some of the reasons why Lavelle has been selected to be a part of such dramatic projects are illustrated in a new brochure. Write for your copy.

Lavelle

LAVELLE AIRCRAFT CORPORATION • NEWTOWN, BUCKS COUNTY, PA.

Between Philadelphia, Pa., and Trenton, N.J.

★ *Positive Mechanically Locked Stem*

★ *Flush Fracture (No Stem Trimming)*

★ *Strong Clinch*

★ *Wide Grip Range*

★ *Positive Hole Fill*

The Cherrylock* "2000" Series Locked Stem Rivet offers every feature desired in an aircraft blind rivet . . . proven high sheet clamp-up with no stem trimming (fractures flush on installation), uniform head seating, complete hole-fill, wide grip range, and positive mechanically locked stem.

Fast, economical, easy installation (with no stem trimming) is available with Cherrylock rivets, using existing Cherry installation guns. You get better fastening at lower installed cost.

One rivet can be used for several material thicknesses, reducing stock requirements and lowering costs. Positive hole-fill, even in oversized holes, simplifies preparation problems to further reduce installation costs. Available in:

A-286 Stainless Steel—Monel—Aluminum

For technical data on the new Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

*Patent Pending

CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

Townsend Company

ESTABLISHED 1916 • NEW BRIGHTON, PA.

In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario

AVIATION CALENDAR

(*Continued from page 5*)

Medical Center, N.Y.C. Sponsor: Air Research and Development Command.

Aug. 18-19—Second International Symposium on Submarine and Space Medicine, Laboratory of Aviation and Naval Medicine, Karolinska Institute, Stockholm.

Aug. 18-19—Electronic Packaging Symposium, University of Colorado, Boulder.

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado, Boulder, Colo.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 7-9—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Instrument Society of America; American Society of Mechanical Engineers; American Institute of Electrical Engineers; Institute of Radio Engineers; American Institute of Chemical Engineers.

Sept. 8-9—1960 Engine and Operations Symposium, Airwork Corp., Millville.

Sept. 12-13—Sixth Annual Titanium Metallurgy Conference, New York University's College of Engineering, Bronx, N. Y.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 25-27—24th Annual Convention, International Northwest Aviation Council, Harrison Hot Springs, British Columbia.

Sept. 27-30—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif. Cosponsors: USAF; U.S. Army; U.S. Navy; National Aeronautics and Space Administration; Atomic Energy Commission.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton-Palace Hotel, San Francisco.

Who put the cart before the horsepower?

Autonetics did. Autonetics foresaw that the electronic systems inside a modern weapon would become as important as the frame that enclosed them... foresaw that the twin bugaboos would be time and talent: the time it would take a swarm of skilled technicians with meters and hand probes to make a thorough maintenance test—and the scarcity of such technicians. That's why Autonetics, together with the Department of Defense, set out to automate the whole procedure.

Result: carts that contain today's most versatile automatic checkout systems. These systems match the needs of the majority of manned and unmanned weapon systems. Adaptive equipment for testing special electronic systems can be packaged in similar carts and plugged into the basic cart. The system is thus complete and readily mobile.

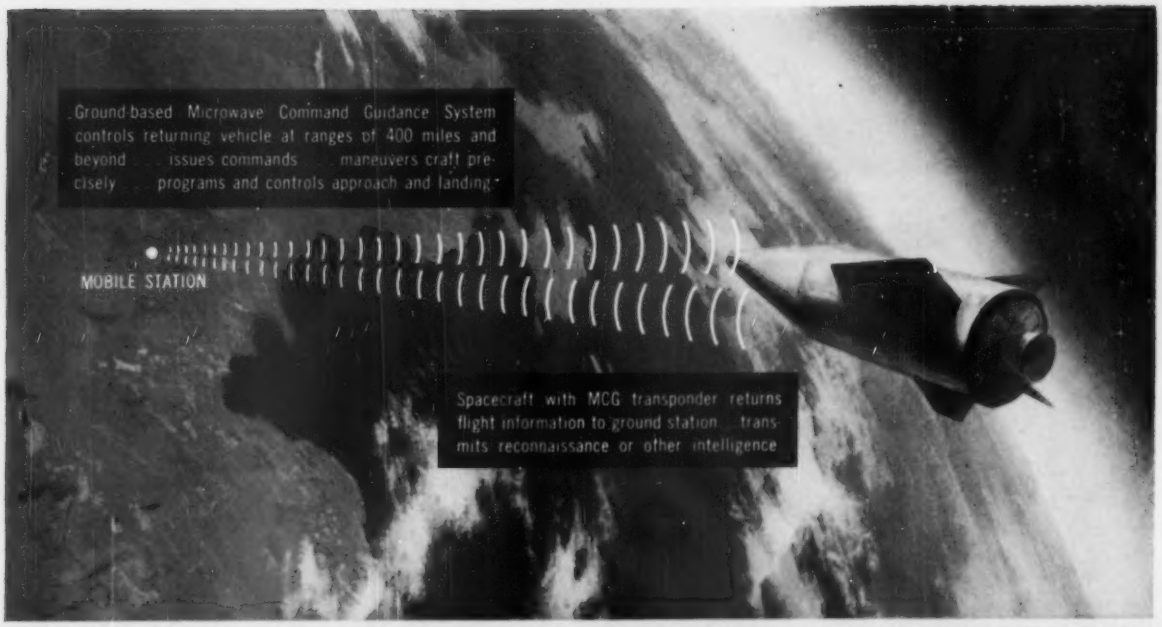
Here's the payoff: as part of the Naval Avionics Support System, these new automatic checkout centrals will do the job 100 times as well—and with infinitely greater accuracy. All the operator needs to know is which button to push. This is the reliable way to find fault before you fly.

Automatic checkout centrals by Autonetics

DOWNEY, CALIFORNIA

A DIVISION OF NORTH AMERICAN AVIATION, INC. REGIONAL OFFICES: WASHINGTON, D.C. AND DAYTON, OHIO

INERTIAL NAVIGATION / ARMAMENT AND FLIGHT CONTROL / COMPUTERS AND DATA SYSTEMS


Ground-based Microwave Command Guidance System controls returning vehicle at ranges of 400 miles and beyond issues commands maneuvers craft precisely programs and controls approach and landing
MOBILE STATION
Spacecraft with MCG transponder returns flight information to ground station transmits reconnaissance or other intelligence

Supersonic drones and other craft are remotely controlled with "in-cockpit" accuracy by Sperry Microwave Command Guidance. MCG equipment is packaged in air-transportable van, or can be installed in director aircraft. Flight path is traced automatically on plotting board.

How Sperry Puts Spacecraft "On Instruments"

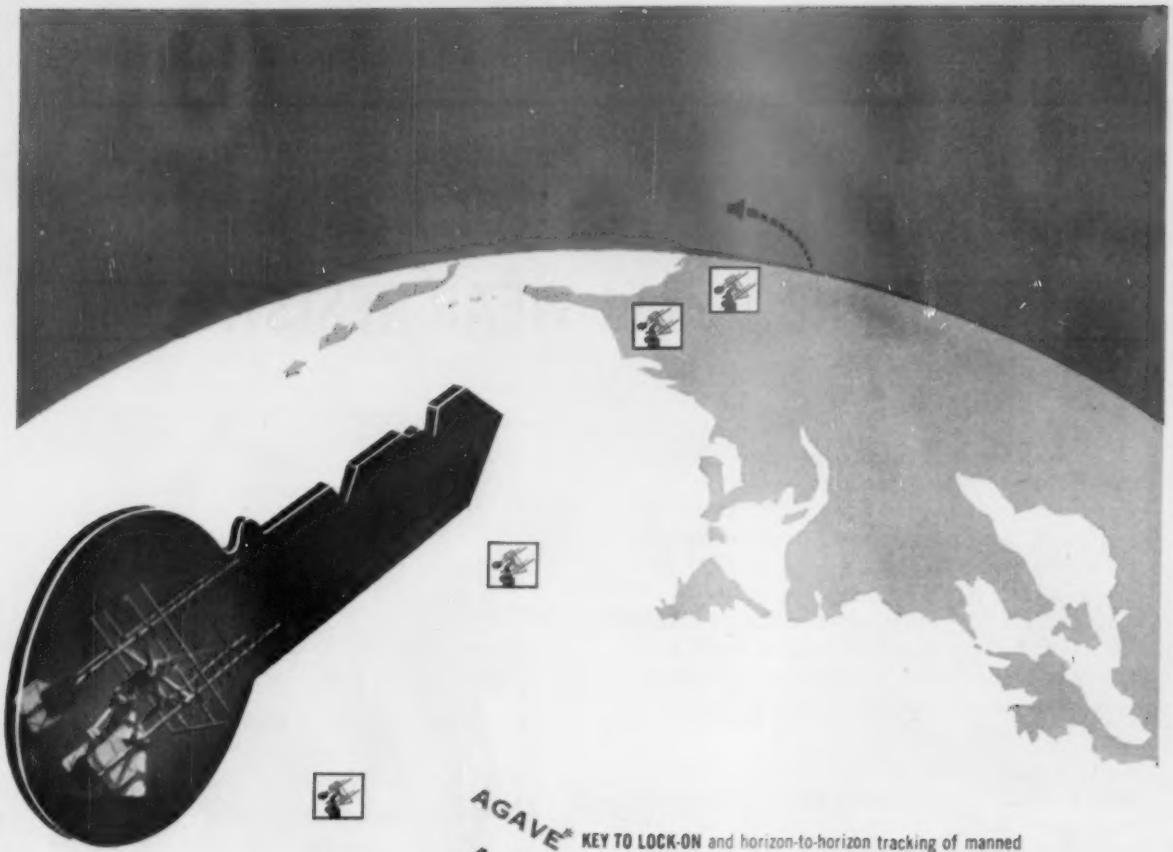
SPERRY

One of the big questions in returning spacecraft to earth—how to "steer" with precision—is being answered by Sperry. Sperry's Microwave Command Guidance System, developed with the Air Force, will fly any kind of vehicle remotely 400 miles and beyond, exercising levels of precise control far beyond the ability of a skilled pilot.

Sperry Microwave Command Guidance can establish the optimum approach path and provide accurate landing control. It issues high-speed commands, monitors performance, plots course, transmits intelligence in both directions. It can control any reconnaissance vehicle, as well as returning spacecraft, and is ideal for test-range instrumentation applications.

Already proven in remote control of supersonic vehicles, MCG is a compact, mobile package in an air-transportable van . . . can also "go airborne" to avoid terrain problems and extend range. Write for system information pertinent to your project.

SPERRY PHOENIX COMPANY, *DIVISION OF SPERRY RAND CORPORATION, PHOENIX, ARIZONA*



AGAVE* **KEY TO LOCK-ON** and horizon-to-horizon tracking of manned space capsules

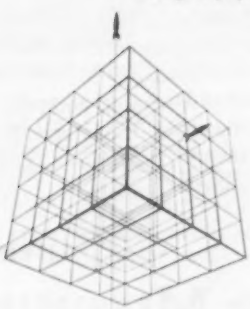
AGAVE **KEY TO NARROW-BEAM-RADAR ORIENTATION**; key to immediate acquisition of lower-level airborne signals and subsequent reacquisition if target is lost (direct transfer of gimbal angles)

AGAVE **KEY TO AUTOMATIC-TRACKING ANTENNAS** for extended range telemetry . . . a broadband front-end passes the entire telemetry band simultaneously . . . acquisition and tracking are independent of carrier modulation

AGAVE **KEY TO RANGE SAFETY** where angle-only information is sufficient (two AGAVEs provide complete position data)

AGAVE **KEY TO DRONE GUIDANCE** when augmented by Cubic DME (Distance-Measuring Equipment), a command generator, and a miniature airborne decoder

AGAVE **ONE OF MANY** challenging Space-Age projects at Cubic inviting employment inquiries from interested engineers



CUBIC CORPORATION
SAN DIEGO 11, CALIFORNIA

***AGAVE:** Automatic Gimballed-Antenna Vectoring Equipment

3M COMPANY CHEMICALS

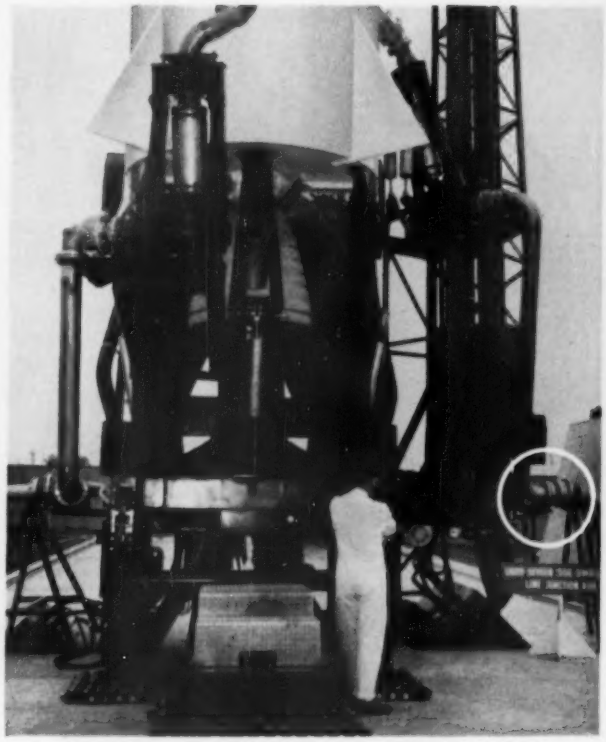
THE RAW MATERIALS OF PROGRESS

Liners of KEL-F® BRAND PLASTIC for ball joints... FUEL-PROOF and WEAR-RESISTANT

Flexible ball joints (see photo below) manufactured by the Barco Manufacturing Company of Barrington, Illinois, provide for swiveling or angular flexing and thermal contraction in fueling lines for today's rocket powered ballistic missiles. Like the pipeline, these joints must withstand the corrosive action of such highly volatile fuels as LOX and JP fuels 3, 4 and 5. A sealing and lining agent was required that would make the joints impervious to the corrosive action of these fuels.

Barco Manufacturing Company found the answer. KEL-F Brand Plastic was supplied to them in sheet form. Barco, in turn, die-cut the KEL-F plastic into the required shapes for use as liners and sealers in the swivel mechanism of the ball joints.

Why KEL-F Plastic? Because the corrosive action of high energy rocket fuels can't faze it. Because cold can't shatter it . . . heat can't melt it. It's performance proved. KEL-F Plastic withstands a temperature range of −320° F. to +425° F. In addition, its excellent flexibility and high impact and compressive strength provide an extra safety measure to the joints to insure against dangerous blow-outs and costly leakage.



KEL-F Plastic is ideally suited for many uses in the field of rockets, missiles and aircraft because it is chemically inert, thermally stable, has high impact, tensile and compressive strength plus zero moisture absorption and easy moldability. Among its many uses: O-rings, LOX lip seals, valve diaphragms, flow meters and fuel bladders.

For complete performance characteristics, write today specifying area of interest to: 3M Chemical Division, Dept. KAW-60, St. Paul 6, Minnesota.

"KEL-F" is a Reg. T. M. of 3M Co.

CHEMICAL DIVISION

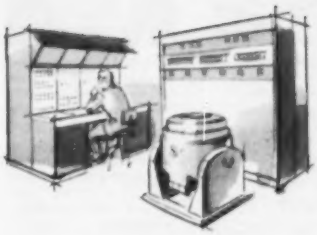
MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

The important advances in environmental testing come from MB

NEW MB automatic spectrum equalizer to revolutionize random vibration testing



Heart of the MB automatic equalization system is the multi-channel transistorized amplifier which provides amplitude control. The plug-in printed circuit assembly shown above contains four of these channels. Frequency control is provided by the 80-channel filter assembly in the compact metal box.

CONSTITUTING a major breakthrough in applied electronics, MB's new *automatic* spectrum equalizer now means not only more accurate vibration testing . . . but tremendous savings as well in test time and money for missile and aircraft manufacturers.

The reason: set-up time has been completely eliminated. Using solid state magnetostrictive filters with correct phase properties plus servo systems on each of eighty channels in the 15 to 2000 cps spectrum, vibration shaker systems can be completely equalized within 5 seconds.

Savings in time and labor over previous equalization methods can easily mean thousands of dollars per missile tested. Still another advantage is the greatly increased accuracy of accumulated test data. The spectrum is continuously monitored in narrow bandpass channels and compensation automatically made *during* test run.

Automatic spectrum equalization is another of MB's important and continuing contributions in the field of environmental testing.

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC., 1078 State Street, New Haven 11, Conn.

New tool for microminiaturization

Now Build Your Own Micromodules with RCA's Basic Micromodule Laboratory Kit

RCA's new Basic Micromodule Laboratory Kit provides a revolutionary new way to meet the challenge of microminiaturization. It places full facilities for building and encapsulating experimental Micromodules directly in the hands of your own design group. From breadboard to finished Micromodule, you can evaluate your own circuits, assemble and encapsulate to your own specifications.

COMPLETE KIT

The new kit provides all of the tools and instructions needed to convert many of your existing electronic-circuit designs into Micromodule equivalents: encapsulants, encapsulating mold, curing oven, cleaning materials, special microscope, special jigs, special air-abrading tools and automatic-control equipment—all are supplied with your Basic Micromodule Laboratory Kit. The only additional equipment you need to build your own sample Micromodules in your own laboratory is a tank of nitrogen and ten feet of workbench.

STEP-BY-STEP INSTRUCTIONS

The Design Manual and Instruction Manual supplied with the kit give the step-by-step procedures for converting to Micromodular form and for building your own micromodules. The Design Manual shows, for example, how to divide circuits into units to suit Micromodule requirements—how to determine the positions of microelements in the assembled Micromodule—how to lay out the wiring for interconnections between Micromodules—how to make mechanical layouts. The Instruction Manual clearly explains and illustrates all of the techniques for building and testing experimental Micromodules. The stock of microelements and other components provided in the kit can be used for a wide range of circuit designs.

DESIGN ADVANTAGES

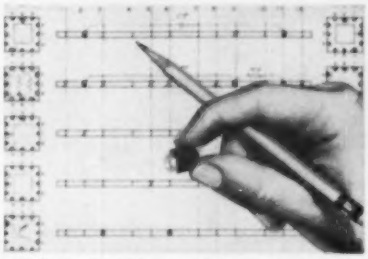
Give your equipment designs the inherent advantages of microminiaturization now, with the RCA Basic Micromodule Laboratory Kit—component densities to several hundred thousand parts per cubic foot, greater reliability through redundancy, room to improve accuracy, precision, control, sensitivity, and selectivity.

AVAILABLE NOW

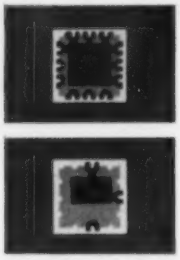
Your RCA Field Representative is ready to give you the details on the new RCA Basic Micromodule Laboratory Kit. He also has complete information on standard Micromodules available from stock for application in your new or existing designs. Remember, micromodularized end-equipment is probably your number one goal today—and it's ready for you now with RCA Micromodules. Give your local RCA office a call today!

For your copy of RCA's new, complete Micromodule Design Manual, send $2.00 today to RCA Semiconductor and Materials Division, Commercial Engineering Section F-112-NN, Somerville, N. J.

With RCA's easy-to-use new Basic Micromodule Laboratory Kit you design and assemble your own experimental Micromodules... minimize time lag between design and testing... eliminate outside engineering costs... maintain internal control of your new designs. Air-abrading technique illustrated makes it possible to tailor Micromodules to your own requirements from a minimum stock of "universal" microelements.



The Basic RCA Micromodule Laboratory Kit is furnished with all components, equipment and manuals necessary for designing, assembling and encapsulating your own experimental Micromodules from worksheet to finished Micromodule.



Microelement ceramic capacitor (magnified) with "universal" multiple terminations (top) can be abraded to give custom tailored capacitance values and provide the terminal arrangement you want (bottom).

RCA SEMICONDUCTOR & MATERIALS DIVISION FIELD OFFICES

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NATO Royal Flush V Reconnaissance Competition — 66th TAC Recon Wing crew rushes exposed film from RF101 to photo lab at Bremgarten AFB, Germany. Cameras shown are Fairchild KA-2's.

FAIRCHILD SALUTES

the 4th Allied Tactical Air Force

First Place winner — NATO Aerial Reconnaissance Competition

Winners of the annual NATO aerial photo-reconnaissance contest held in West Germany on May 16 to 19 were the American and French teams of the 4th Allied Tactical Air Force as reported in a U.P.I. dispatch appearing in the May 20th issue of "The Stars and Stripes". Popularly known as "Royal Flush V", the contest featured reconnaissance teams from the United States, France, Great Britain, Belgium and the Netherlands.

As in previous Royal Flush exercises Fairchild Aerial Cameras played a prominent role. These included Fairchild models KA-2, K-17, K-22, and K-47. A decisive factor in the score of the winning team was the performance of the K-47 night reconnaissance camera system which was flown in an RB-66 in the night competition.

Fairchild, the world's leading producer of aerial reconnaissance systems, has currently under development some of the most advanced systems geared to the space age. Typical of these developments is an air-to-ground Photo Transmission System which is now undergoing flight tests.

For further information write to —

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CAMERA AND INSTRUMENT
CORPORATION

French, U.S. Take Firsts In Royal Flush

Bremgarten, Germany (UPI) —American and French air reconnaissance teams took first place in an annual NATO aerial photography contest held here.

The contest dubbed Royal Flush V, drew more interest than usual this year because of the furor over an American reconnaissance plane shot down in Russia.

However, a U.S. Air Force spokesman said there was no parallel between the type of military reconnaissance operations tested here and those used in counter-intelligence work.

Teams from the U.S., France, Great Britain, Belgium, and The Netherlands took part in the three-day contest which ended Thursday. Eight other NATO nations sent non-flying participants.

The results, a spokesman said, "indicate beyond doubt that the free world takes second place to no one in reconnaissance."

In the long-rang
the British-built C
outscored the V

Barest Data Given

He added, "The pilots were given only the barest data to locate their targets and there was not an instance when one of the flyers failed to photograph his designated area."

The target areas were scattered throughout western Europe.

More than 1,000 flyers took part in the exercise. They flew into the French air base of Bremgarten near Freiburg from points throughout western Europe.

French and American teams of the 4th Allied Tactical Air Force came out on top in final tabulations, and were to receive a trophy Friday from Gen. Paul Stehlin, new chief of staff for the French Air Force.

In short range co
RF84 Thunderfla
French Air Forc
the swift F
Royal Air

Engineers — Investigate career opportunities at Fairchild

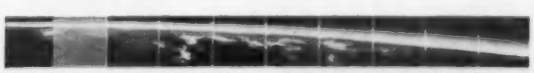
DEFENSE PRODUCTS DIVISION

Robbins Lane, Syosset, L. I., N. Y.

Day by day the Polaris missile gets nearer to its first submarine test firing... nearer the day when, operational, it will become one of our nation's most formidable deterrents to aggression. For with submarines serving as mobile missile launching pads, any target on earth is within deadly striking range if retaliation becomes necessary.

The Polaris-launching submarines are splendidly fitted out not only to aim and fire and accurately guide the missile, but also to defend themselves. Advanced Sperry submarine equipment contributes to both these functions. For precise navigation there is SINS (Ship's Inertial Navigation System), automatic steering and stabilization, depth detectors, gyrocompasses, diving and maneuvering controls, instrumentation, and computers... and the NAVDAC computer which correlates all navigation data. For anti-submarine warfare the subs have Sperry torpedo fire control systems, sonar sub detection equipment, the attack periscope itself. At two special laboratories both aspects of the Polaris program are being refined and integrated: one of which simulates submarine navigation, the other the environments of the sea.

Sperry's role in the Polaris program is typical of the Company today, achieving through specialized divisions an integrated capability that is contributing to every major arena of our environment. General offices: Great Neck, N. Y.



SEA · SURFACE · AIR · AEROSPACE

SPERRY

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Normalizing Alloy Steels

There are several forms of heat-treatment commonly employed in the processing of alloy steels. Each in its own way modifies the mechanical properties and structures of steel, and each is chosen with a definite objective in mind. The five usual forms of treatment are normalizing, annealing, spheroidize-annealing, quenching and tempering, and stress-relieving.

In this particular discussion, let us consider briefly the purposes and effects of normalizing.

Normalizing is an operation in which the steel is heated to approximately 100 deg F above the upper transformation range, then cooled in still or agitated air. The basic purpose is to refine the prior structure produced by variations in finishing temperatures encountered in rolling or forging. The structure resulting from normalizing, being more uniform, will help create improved mechanical properties when the steel is subsequently reheated, liquid-quenched, and tempered.

There are times when large steel parts (heavy forgings, for example) cannot be liquid-quenched because of their size. In cases of this nature, the heat-treatment must consist of single or multiple normalizing followed by tempering.

High-temperature normalizing is sometimes used for grain-coarsening low-carbon alloy steels to promote machinability. (In high-temperature normalizing, steel is heated to more than 100 deg F above the upper transformation range.) At times it is possible to machine a steel in the air-cooled condition, the governing factor being the alloy content. However, the highly alloyed analyses may require annealing or tempering after normalizing, to decrease the hardness.

It is essential, when normalizing is employed, that free circulation of still or agitated air be provided. When air-cooling of individual bars or forgings is not practicable, the furnace charge should provide for some means of separation, such as racks or spacers.

If you would care to know more about normalizing, or any other phase of heat-treating, you are invited to consult with Bethlehem metallurgists. They are always glad to give you any help you need.

And remember that Bethlehem makes the full range of AISI standard alloy steels, as well as special-analysis steels and all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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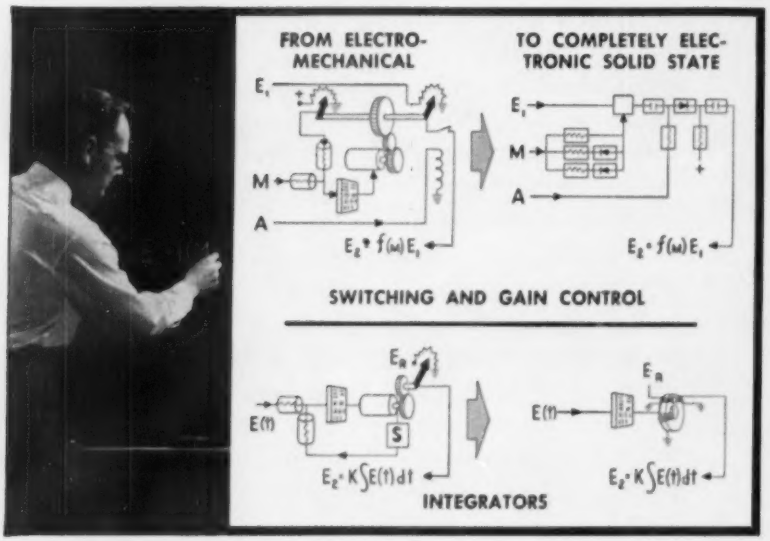

One of the chief assets an associate contractor can offer is his ability to advance "the state of the art." This capability is part and parcel of Eclipse-Pioneer KNOWMANSHIP.

Take automatic flight control systems. In 1954, E-P flew the first successful, fully-transistorized system—forerunner of models now flying or ordered for 34 different airlines of the world, as well as the air forces and navies of the United States and Canada. Currently—on the crest of new E-P breakthroughs in solid-state electronic circuitry—we are developing an automatic flight control system *with no moving parts* between the input sensors and output servos. Effect of eliminating conventional rotating shafts, gear trains, cams, motors, relays, etc., from a typical system will be to *halve* flight control system size, weight, power consumption, and cost. *At the same time, operational reliability will be increased.* The new solid-state systems will be particularly well suited to operation with the new generation of airborne digital computing systems.

If you seek advanced "state of the art" thinking and capability for *your* contracting team, E-P KNOWMANSHIP could well be the answer. To find out, call, wire, or write us today.

69% of E-P's procurement dollars go to small business.

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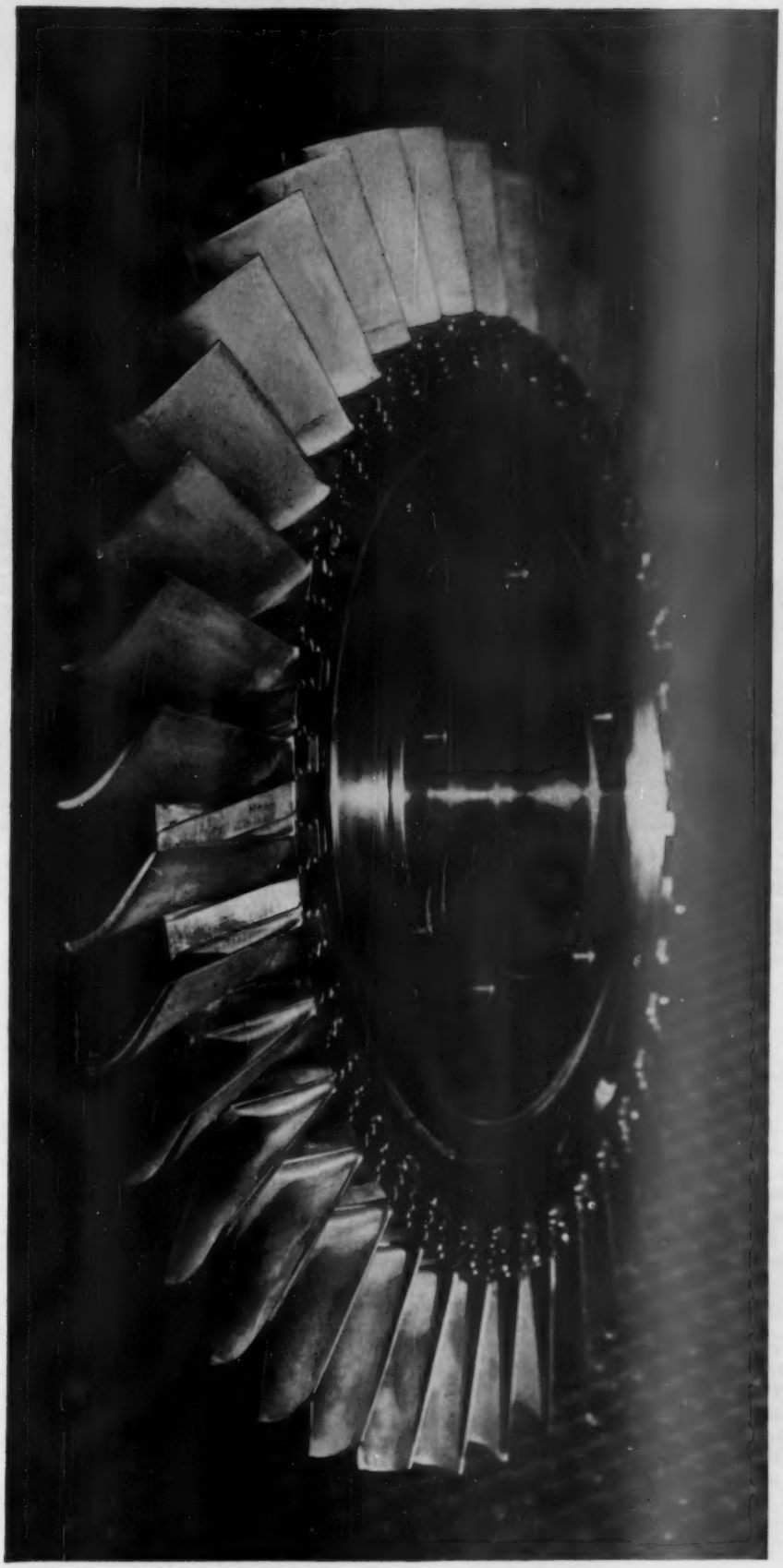

complex jet engine componentry

This complete jet turbine wheel is a product of Kelsey-Hayes, Jackson, Michigan plant. Its high standards of performance reflect Kelsey-Hayes' capabilities in the production of crucial rotating machinery, components and assemblies.

As a major subcontractor to the aerospace industries, Kelsey-Hayes' capabilities also include the production of vacuum-induction-melted alloys, as well as design, development and production of advanced thrust vectoring devices.
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19 PLANTS: Detroit and Jackson, Michigan; Los Angeles; Philadelphia and McKeesport, Pennsylvania; Springfield, Ohio; New Hartford and Utica, New York; Davenport, Iowa; Windsor, Ontario, Canada.

A possible Earth to Venus Trajectory (dotted line) for 107 day flight programmed for burnout conditions over Cape Canaveral on 16 January 1961 at 15.65 hours (ephemeris time). Illustration shows positions of Earth, Venus, vehicle at eighteen day intervals.

MISSILE AND SPACE VEHICLE DEPARTMENT

...center for missile and space technology research and development at General Electric

Progress in defining space trajectories

Astrodynamicists at General Electric's Missile and Space Vehicle Department are currently mapping space . . . determining trajectories for flights from the Earth to other bodies of our solar system.

Under these funded studies, MSVD has recently completed a program of error analysis of trajectories to the Moon involving the four-body gravitational system, as well as a study of flight paths to Venus.

From consideration of the total gravitational field, specific space missions are computed when date of departure, trip time and launch site are specified. The exact launch burnout conditions are determined for the time of day which maximizes the additional boost caused by the Earth's rotation. Employing new techniques, MSVD scientists have made these determinations with as few as three corrective computer runs. These methods also can be applied to flights to other planets of our solar system.

In addition, the Department is developing methods to determine orbital parameters of earth satellites using only Doppler information. This MSVD experience in tracking techniques and computer programs permitted analysis of the Russian Lunik III trajectory.

For more information about MSVD's progress in all phases of space technology, write for the new Department Bulletin, Section 160-92, General Electric Co., Missile and Space Vehicle Department, Philadelphia 1, Penna.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT

A Department of the Defense Electronics Division

Scientists and Engineers interested in career opportunities in Space Technology, contact Mr. T. H. Sebring, Dept. 160, MSVD

June 27, 1960

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COVER: Chance Vought F8U-2N Crusader all-weather Navy fighter will begin aircraft carrier qualification trials this summer. The F8U-2N is powered by a Pratt & Whitney J57-P-20 turbojet engine rated at 18,000 lb. thrust maximum at sea level. Armament includes four Sidewinder air-to-air missiles. For other photos of the F8U-2N, see pp. 84-85.

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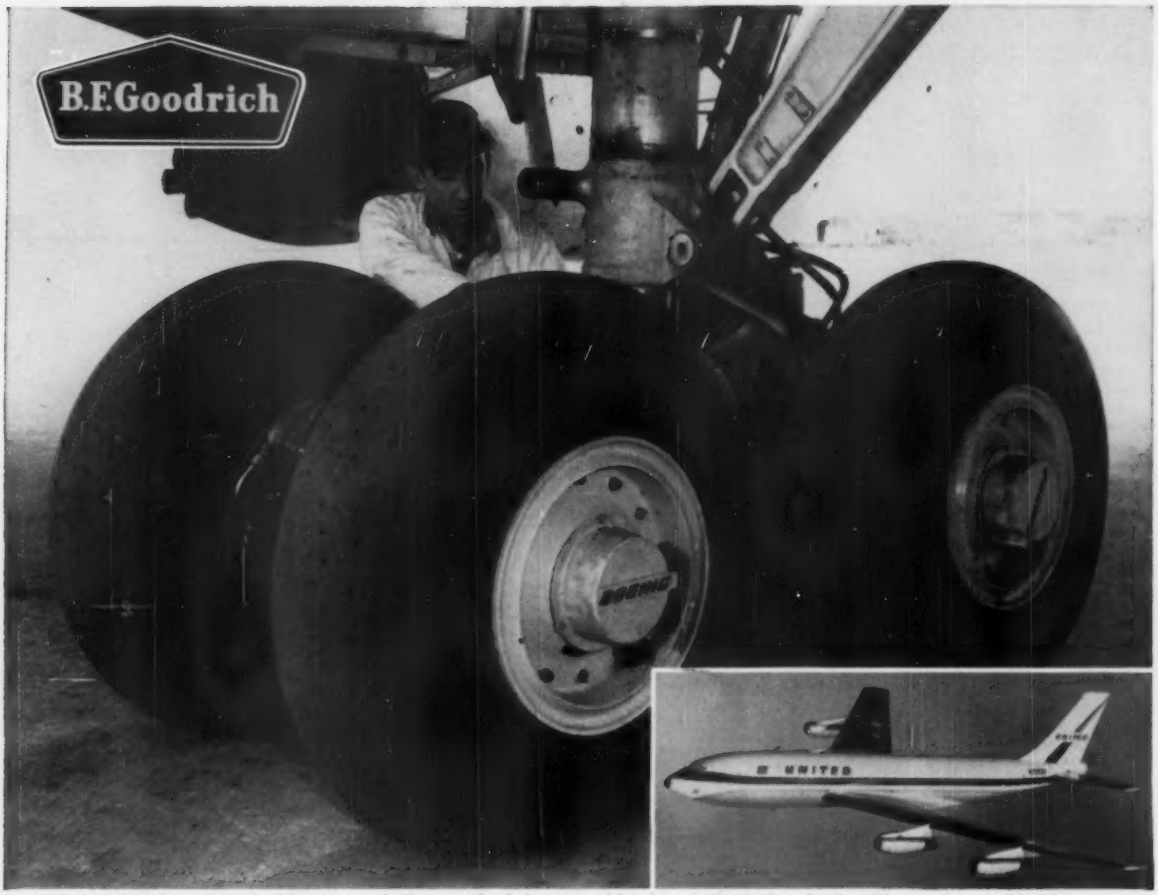

Boeing 720 is equipped with 34x9.9 dual nose wheel tires, and four 40x14 tires on each main landing gear. B.F.Goodrich supplies fabric-tread tires, as well as the wheels and brakes for this aircraft. In "refused takeoff" tests for certification, the 720 was accelerated to 165 mph, then braked to a stop. There were no tire failures in 14 such test runs.

Real cool tires for United's new Boeing 720's ... B.F.Goodrich dimpled fabric tread

These cooler running BFG fabric-tread tires, along with BFG wheels and brakes, are now going into service on United Air Lines' newest jets ... the Boeing 720.

BFG fabric-tread tires last longer...the secret is in "unitized" construction. In conventional tires, flexing between carcass and tread causes heat build-up at high speeds. In the fabric-tread tire, reinforcing fabric is built into the tread rubber. This reduces internal tread flexing, tires run cooler. And the dimple design provides superior resistance to cutting and chipping. These features mean savings in time and money.

BFG fabric-tread tires, used on all U. S. commercial jets and virtually all first-line military jets, have been qualified to speeds as high as 300 mph. For information on your requirements, contact *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept. AW-7B, Akron, Ohio.*

Cross-section of B.F.Goodrich fabric-tread tire shows how fabric laminates are built into rubber tread stock.

B.F.Goodrich aviation products

EDITORIAL

National Defense as an Issue

As both Republican and Democratic parties head toward their convention halls to nominate candidates for the fall presidential election, it is evident that the issue of national defense will loom larger than any of the professional politicians anticipated. It may be that national defense will become the paramount issue in the contest to choose a President to direct the destiny of this country for the next four years.

If this occurs it will not represent any revolutionary change in human nature, for survival has always been a more basic human concern than the size of a tax bill or bank account. What has changed in the past six months has been the American people's perception that survival is indeed at stake and that the threat from the Sino-Russian Communist bloc is fact, not a fiction of campaign oratory.

This perception has been slowly accumulating during the two and a half years since the orbiting of Sputnik I provided dramatic confirmation of the startling Soviet technical progress that had been reported consistently by a few sources, including AVIATION WEEK, since 1954. The impact of both this Soviet technical progress and the reporting of it by Western sources was deadened by two factors:

• **First, the steadfast denial** by top level U. S. government officials that this technical progress was occurring, and later when this position became untenable, pursuit of a consistent public policy of deprecating the effects of this Soviet progress on our own position of international leadership.

• **Second, the difficulty of authenticating** the facts on Soviet technical progress in the early phases of this era when the Soviets were still trying to keep their developments under security wraps.

Since October 1957, when Sputnik I went into orbit, the Soviets have lost no opportunity to publicly demonstrate their technical progress in the key technologies on which modern power is based. The series of space shots, the 7,600 mi. ICBM shots into the Pacific and their concerted attempt to gain all of the major world records for aircraft have provided some international authentication of their claims.

But even more dramatic have been the tragic events of the Paris summit conference and the withdrawal of invitations for President Eisenhower to visit the Soviet Union and Japan. This has brought home to the American people more than anything else that there has been a deterioration of our military power on the international scale, or at least that a general impression to this effect has encouraged our opponents to action they would not dare if the margin of our military superiority and our determination to use it when necessary were not open to debate.

So we come to the summer of 1960, when one of the major considerations of both parties must be how their candidates will be measured on this primary issue of national survival. Beyond looms the election campaign, when the American people are certain to apply this yardstick of a candidate's understanding and capability on the national defense problem as a critical measurement of his ability to lead this nation.

A new President will find the critical problems of national defense will not even wait for the triumph of inaugural day. They will be with him from the morning after the election returns are tallied, and there are many grave decisions that he will have to begin considering long before he officially takes office.

Here are some of the early decisions a new President will have to make on national defense:

• **Is the defense budget adequate** either in fiscal resources or in the direction in which these resources are being oriented? The organization of the Fiscal 1962 defense budget will already be well under way by the time a new President takes office, and he will have to inject his defense philosophy into its preparation immediately after the election if it is to become effective.

• **Can the portion of the national resources** devoted to defense be effectively utilized under the present organization of the Defense Department, or is a further managerial revolution required to get maximum effective military power out of the resources applied?

• **Can we have any assurance** at all of maintaining an effective deterrent force during the next four years without immediate decisions to prepare for an adequate airborne alert for Strategic Air Command's B-52 heavy bomber fleet? Will the failure to put at least 25% of this heavy bomber force on airborne alert, coupled with a major increase in Soviet air defense capability, produce a shift in the deterrent equation that might tempt the aggressive use of a major ICBM force?

• **Can we handle fringe wars** and aggressive military probings without a ground force equipped with modern weapons and capable of maximum air transportability at jet speeds?

• **Are we putting the effort required** into anti-submarine warfare?

• **Are we pushing with all the capability** of our national resources along a broad research spectrum to ensure that the major technical breakthroughs on new weapons are made under our aegis, rather than by a potential aggressor?

These are only a few of the defense problems a new President must face. All of them have been made more acute by the failure to face them fully and determinedly during the past three years, even after the nature and strength of the Communist threat had been clearly shown.

There is little doubt that the next four years will be one of the most perilous periods in our national history in the face of the military, economic and intellectual challenge of communism.

The candidates, the delegates concerned with their nomination, and the voters who will make the final decision should use this yardstick of national defense as a key measurement of their choice for a national leader for the next four years. We have every confidence that they will.

—Robert Hotz

On the new J85 Jet Engine: Lightweight, dependable Kidde high-temperature actuators!

In order to move the variable exit nozzle on the afterburner of the J85 engine, G.E. uses three lightweight Kidde ball screw actuators, similar to the unit shown above. Each actuator employs a ball screw mechanism that weighs only 0.6 pounds and has a shaft diameter of ½ inch.

The Kidde ball screw actuator shown can carry loads up to 1,400 pounds and can operate continuously in a temperature range of from −65° F. to +840° F. At high temperatures, these mechanical ball screws are more reliable than electrical, pneumatic or hydraulic systems. Because they have a minimum amount of back-lash and friction, they can easily perform functions calling for the rapid reversibility of heavy loads. This makes them especially suitable for applications such as thrust reversal, gimbaling rocket or jet engines, atomic scramshaft controls and space flight controls.

Like G.E., you, too, may have a problem which can be solved with Kidde ball screw actuators. For more information on these dependable actuators, write Kidde today.

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WHO'S WHERE

In the Front Office

Albert Roeper, a director, Flight Refueling, Inc., Baltimore, Md. Mr. Roeper is the company's treasurer and controller.

R. F. Onsrud, board chairman, Onsrud Machine Works, Inc., Niles, Ill., and **Charles R. Onsrud,** president.

Charles C. Colozzi, president, United States Gasket Co., Plastics Division of Garlock, Inc., Camden, N. J.

Samuel L. Baraf, president, United Transformer Corp., New York, N. Y., and **Henry Russell,** vice president.

Tore N. Anderson, executive vice president and general manager, FXR, Inc., Woodside, N. Y.

Benno Von Mayrhauser, a vice president, Baird-Atomic, Inc., Cambridge, Mass.

Julian Rogoff, executive vice president, Burndy Corp., Norwalk, Conn. **Fred Heller** succeeds Mr. Rogoff as manager of the Omaton Division.

Samuel P. Crago, vice president and general manager, B G Corp., Ridgefield, N. J.

Dr. Robert E. Roberson, vice president, Systems Corporation of America, Los Angeles, Calif.

Dr. Herman A. Bruson, vice president-research, Chemicals Division, Olin Mathieson Chemical Corp., with headquarters at New Haven, Conn.

William D. Stewart, an assistant vice president, American Airlines, Inc. Mr. Stewart continues as Director of Regulatory Proceedings.

A. P. Smibert, financial and commercial manager of Rolls-Royce of Canada, Ltd., succeeding Ian Turner, resigned.

The Aeronautical Group of companies of A. V. Roe Canada, Ltd., has established a Washington, D. C., office, and **John R. Douglas,** Future Products Defense Manager of the Aeronautical Group, has been appointed Washington representative.

O. A. Linse, assistant to the vice president of the Pomona (Calif.) Division of the Marquardt Corp.

Assistant Vice President **William T. Caldwell** will head the newly established Marketing Department of Amelco, Inc., Los Angeles, Calif.

Honors and Elections

Joseph J. Tymczyszyn, a senior engineering test pilot and flight test engineer of the Federal Aviation Agency, has been named recipient of the Octave Chanute Award for 1960 by the Institute of the Aeronautical Sciences.

Dr. Miles C. Leverett, manager-development laboratories for General Electric's Aircraft Nuclear Propulsion Department, has been named president of the American Nuclear Society for 1960-61.

Dr. James N. Waggoner, medical director for The Garrett Corp.'s AiResearch Manufacturing Division of Los Angeles, has been elected a Fellow of the Aerospace Medical Assn.

Richard W. Powell, manager of Aerojet-General's Avionics Division, has been elected chairman of the Aerospace Industries Assn.'s Electronics Equipment Technical Committee.

(*Continued on page 95*)

INDUSTRY OBSERVER

► Deadline for proposals on NASA's orbiting astronomical observatories project is July 5. Satellites in this project will be basic shells carrying stabilized platforms and experiments that vary with each shot. They were planned as Vega payloads before that vehicle was canceled, but now will be carried by Atlas-Agena Bs (see p. 62). NASA has responsibility for stabilization, guidance, power supply and telescope finder system, and university and other scientific groups have responsibility for experiments.

► **First launching of USAF's hyper-environmental test system 609A is tentatively scheduled for June 29 from Cape Canaveral, Fla. The 609A is derived from the NASA Scout solid rocket vehicle, but first vehicle will be much shorter than Scout and its first stage will be the Thiokol XM-33, which is used as the second Scout stage. Final stage is Naval Ordnance Test Station spherical solid propellant rocket. Probe will measure radiation to an altitude of several thousand miles.**

► Aerojet engines powering USAF-Martin Titan first stage have been simplified to incorporate internally-contained starting system which already was in use in second stage. Earlier missiles used a high-pressure system in the launch stand to start the engines' gas generator. Self-starting principle will be carried over into Titan I first stages.

► **Most Convair Atlas boosters used for civilian space projects will be from the D series, but some will use the uprated engine from the E series. Those with uprated engines will still retain the holddown feature of the D series, however, since instantaneous liftoff featured in the E series is not as desirable for space vehicles.**

► First firing of the more powerful USAF-Convair Atlas E is scheduled from Cape Canaveral, Fla., within the next month and a half.

► **Rolls-Royce is discussing with Hispano-Suiza Co. a licensing agreement for manufacture of the Tyne turboprop engine in France.**

► Ford Motor Co.'s Aeronutronic Division expects to award a contract next month for the retrorocket to be used in the NASA Ranger lunar capsule experiment.

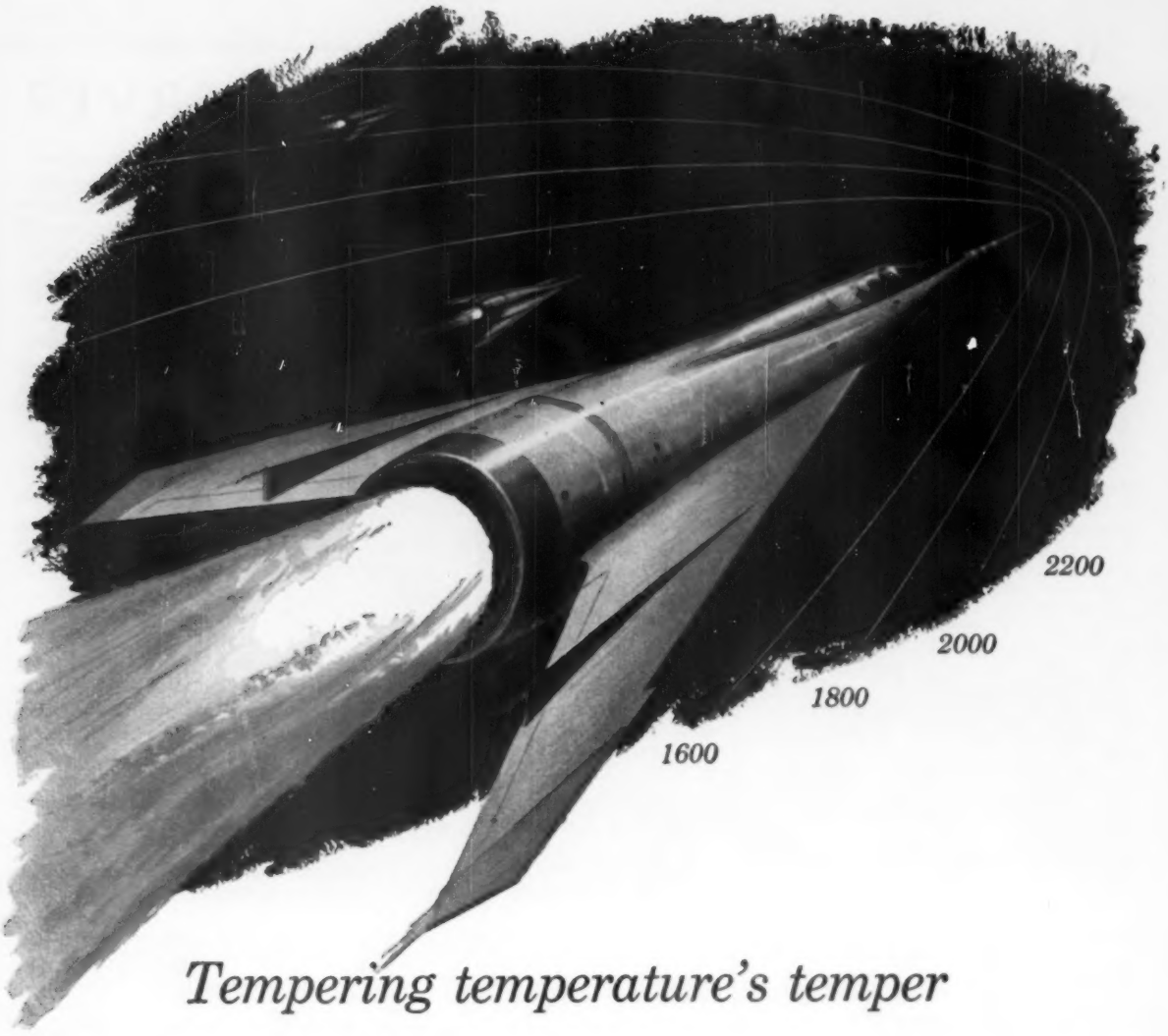
► **Japan plans to send six pilot officers to the U. S. for three-month orientation on Lockheed F-104 fighters in preparation for a five-year training program that will train some 230 pilots and 2,900 ground crewmen. First flight training squadron is expected to be created late next spring. Japan will produce 180 F-104J fighters and 20 F-104DJ trainers in the same five-year period.**

► Navy-Boeing PCH hydrofoil (AW June 20, p. 85) will have capability of extending its foils during operation. Optimum distance above water is expected to increase lateral stability and decrease the tendency to porpoise in heavy weather. Powerplants are two 3,000 hp. gas turbines for foil-borne operations, plus a 600 hp. diesel auxiliary engine.

► **Soviet Union has delivered four single-rotor Mil Mi-4 helicopters, purchased by the Indonesian government, to the Indonesian air force.**

► U. S. Public Health Service monitored an area in a 60-mi. radius around the site of the recent Bomarc IM-99A interceptor missile fire at McGuire AFB, N. J., without finding a dangerous amount of radiation. Burning high explosive from the warhead caused plutonium in the atomic part of the warhead to oxidize and flake off, producing scattering of some alpha particles, but no beta or gamma radiation was detected.

► **Chinese Communists claim to have used civil aircraft for rain-making in Kwangtung, Szechwan and Kweichow provinces and to have sent agricultural aircraft to Kiangsu and Kansu provinces in the Ningsia Hui autonomous region to spray against crop diseases.**



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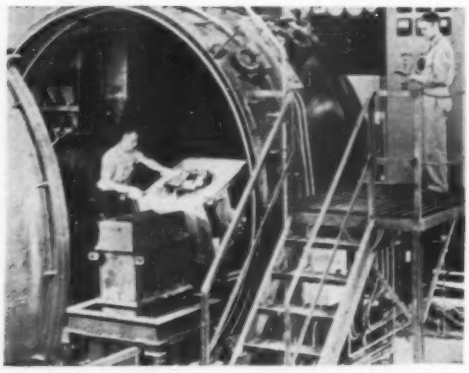

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Washington Roundup

Stable Defense Budget

Services are expected to get their guidelines for the Fiscal 1962 budget by mid-July, and all indications point to a hold-the-line philosophy. Defense Secretary Thomas Gates discussed guidelines with top defense officials last week. Rising personnel costs, along with general inflation, will put another squeeze on weapon system budgets. More manpower cuts may provide some relief to the problem.

Budget Bureau already is expressing alarm over spending increases authorized by Congress for Fiscal 1961 and subsequent years. Administration wants to salvage part of the $4.2 billion surplus projected for the Fiscal 1961 budget. Budget Director Maurice Stans has written Rep. John Taber, top appropriations committee Republican, that congressional spending measures dash taxpayers' hopes of tax reduction and reform and of reducing the public debt.

House Republican policy statement on U. S. strategy and strength maintained that forces provided under current budget concepts are adequate. This extensive report will furnish basic material for Republican convention platform writers. It was approved by President Eisenhower and Vice President Nixon before it was released.

Oliver M. Gale leaves the Pentagon next week to join the Republican National Committee's public relations staff. He wrote the celebrated White Paper defending Administration defense policy, and presumably he will furnish similar material for Republicans answering Democratic defense critics during the campaign. An ex-Procter & Gamble public relations man, Gale served as special assistant to Defense Secretaries Neil McElroy and Thomas Gates.

Soviets Claim Record

U. S. attempt is expected within the next month or six weeks to beat the new Soviet 100 km. closed course speed record. Russia claims pilot B. M. Abdrianov flew it at 1,297 mph. in an unspecified type of single-seat turbojet aircraft. This claim is substantially higher than the record mark of 1,216.4 mph. set in December by USAF Brig. Gen. Joseph H. Moore in an F-105B.

Four U. S. military aircraft capable of topping the Russian record are Navy's McDonnell F4H and USAF's Lockheed F-104, Republic F-105 and Convair F-106.

Aerospace Corp. Plans

New nonprofit Aerospace Corp. will accept contracts from agencies other than the Air Force and expects to build a $50 million annual business. Company is assuming staff functions now being handled for USAF Ballistic Missile Division by Space Technology Laboratories, Inc.

Aerospace Corp. has filled its eleven-man board of trustees. Three new members added to the eight already reported by AVIATION WEEK are Arthur Raymond, who recently retired as Douglas Aircraft Co. senior vice president-engineering to join Rand Corp. as a special consultant; Dr. Chalmers W. Sherwin, professor of Physics at University of Illinois, and Edwin Huddleson, a lawyer and former member of the Gaither Committee.

Richard L. Bean, Lockheed Aircraft Corp. California Division, public relations manager, has taken a leave of absence to join the staff of Vice President Richard Nixon for the election campaign. Bean will serve as assistant to press secretary Herbert Klein, working in the downtown Washington Nixon-for-President headquarters.

Watch for supervision of NASA's Wallops Station to be shifted from Dr. Abe Silverstein's Office of Space Flight Programs to Maj. Gen. Don R. Ostrander's Office of Launch Operations. Wallops is NASA's launch site for Scout satellite vehicles, Aerobee-Hi and other sounding rockets.

Silverstein's office managed to hang on to Wallops in the recent reorganization of launch operations. Since then, the Flight Missions Office at Cape Canaveral, which was to stay under Silverstein as payload coordinating office for launches, has been moved under Ostrander. Wallops is expected to follow the same route shortly.

Wrapup

Senate Armed Services Committee will let House-passed conflict-of-interest legislation for retired military officers die without further action this session . . . House and Senate have approved extension of the 10% passenger transportation tax for another year . . . Legislation aimed against industry influence on Civil Aeronautics Board and other regulatory agencies was approved last week by House Commerce Committee, but chances of enactment are slight this late in the session . . . Sen. Warren Magnuson has proposed authorization of another assistant secretary of commerce to handle all scientific and technological matters. Legislation was requested by the Commerce Department. **—Washington Staff**

Transit Applies Dual Satellite Technique

Smaller sphere separated from navigation test vehicle; wide use of new method seen in space program.

By J. S. Butz, Jr.

Washington—Successful launching of the Navy Transit II-A and a smaller satellite simultaneously by a single rocket has provided the first application of a technique that is expected to see wide use in U.S. space programs, allowing available launching vehicles to put a maximum payload weight into orbit.

The 223-lb., 36-in. diameter Transit II-A experimental navigation satellite and a 42-lb., 20-in. diameter radiation satellite were launched into orbit at 1:54 a.m. EDT on June 22 from Cape Canaveral, Fla., by a two-stage Air Force Thor-Able Star vehicle. Total payload weight was 265 lb., the same as that of the Transit I-B, which was launched last April (AW Apr. 18, p. 29).

The technique of adding a separate satellite to complete a launch vehicle payload is regarded by many as less complex than adding extra instrumentation to a single satellite package.

Addition of instruments has been done in the past in so-called "piggyback" experiments and was done in a small way on Transit II-A, when a small experimental receiver and antenna for the measurement of cosmic noise in space on a frequency of 3.8 megacycles was carried. This equipment was furnished by Canada's Defense Research Telecommunications Establishment. It will provide Canada with design information needed to prepare radio ionospheric refraction experiments which they will conduct with National Aeronautics and Space Administration's "topside sounder" satellite.

Development of the Transit satellites and integration of all payloads is being conducted by the Applied Physics Laboratory of Johns Hopkins University for the Astronautics Group of the Bureau of Naval Weapons. Preparation of the small radiation measurement satellite was the responsibility of the Naval Research Laboratory. Naval Ordnance Test Station supplied an infrared scanner for the Transit II-A payload. It will supply data on the infrared background of the earth which will be used by designers of the Midas early-warning satellite. Information from the scanner also can be used to determine rotation of the satellite.

Orbital parameters of the Transit II-A were considered by the Navy to be well within allowable tolerances. Apogee was 563 mi. and perigee was 460 mi. Desired orbit was a 500 mi. circle. Orbital period was 101.5 min. as soon as a stable orbit was reached. Plane of the orbit was 65 deg., compared with the desired 67.5 deg. inclination.

Navy plans to launch three to six more development satellites before the Transit navigational satellite system becomes operational in 1962. They will be progressively lightened, with the ultimate goal being a weight of about 50 lb. each.

As long as the Thor-Able Star is used, extra satellites probably will be added as they were last week.

Exact nature of the added satellites even for the next scheduled firing in the fall has not been determined. It is believed possible to launch three or more satellites simultaneously and separate them in space so that they safely enter slightly different orbits.

An alternative to multiple satellite payloads as the weight of single satellites decreases is the use of smaller and less expensive launch vehicles. Navy hopes to use versions of NASA's solid propellant Scout vehicle to place the operational Transit satellites into their 500-mi. orbits.

NASA plans at least two multiple satellite launchings. Primary payload for one of these launchings will be the Nimbus, an improved earth-oriented meteorological satellite that will follow the Tiros program.

Need for multiple payload launchings is expected to increase as the current design figures for payloads and booster rockets change. Improved miniaturization, more efficient design and less need for redundant systems will act to reduce payload weight. Improving of the capability of some boosters and cancellation of others is expected by the services and NASA to cause constant adjustment of all satellite programs if maximum use is to be made of the launch vehicles. The dual payload technique for Transit was reported by AVIATION WEEK, June 20, p. 76. It was first tested experimentally by Transit I-B (AW June 20, p. 80).

In the first full scale test of the multiple launch technique last week, the radiation satellite was separated from the Transit II-A as soon as the larger satellite had separated from the Aerojet Able Star second stage. The two satellites were held together by a clamp that was released by small explosive charges. As the clamp disengaged, a spring compressed between the satellites pushed them apart at a relative velocity of 1.5 fps.

Velocity of the small satellite was increased so that it entered a slightly higher orbit than the Transit II-A. As the orbits stabilized and centrifugal force was balanced by gravity the final velocity of the smaller satellite was lower than that of the Transit II-A. Orbital plane of the two separating bodies remained the same, just as those of a satellite and its final rocket stage do.

Weight reduction of the Transit II-A from the 265-lb. of Transit I-B was achieved primarily by removing a chemical battery power supply system, carried as a backup to a solar cell-chemical battery system designed to function at least five years. The number of solar cells around the circumference was doubled and the size of the chemical batteries adjusted so that solar power alone could be used on the Transit II-A.

The life of this solar cell system also is five years, as is that of all transmitting equipment. Heart of this equipment is two ultra-stable oscillators placed in temperature resistant jugs which allow the broadcasting of signals on four frequencies—54, 324, 162 and 216 mc. Similar transmitting equipment was used on Transit I-B.

Four frequencies were used on the development satellites to determine the correction needed to be made by ground stations which were measuring the doppler frequency shift on the ground to get a navigational position fix from the satellite. It has been shown already, however, that two broadcasting frequencies are sufficient to obtain these corrections.

Final major component needed in the Transit operational satellites, a digital computer, will be sent into orbit for the first time in the shot next fall. This computer will allow the satellite to store its orbital trajectory data and broadcast it once every minute. This data will be injected into the satellite equipment by a single ground station.

Any vessel at sea that measures the doppler shift of the satellite's signal and receives the orbital trajectory information will be able to plot its position. It is planned that vessels of all nations

will make use of the system. Present cost estimates for shipboard equipment necessary to take advantage of the Transit system is between $2,000 and $4,000 for the simplest units. These would be essentially radio receivers, and the shipboard navigator would have to use his slide rule to compute his position. The accuracy with this method probably will be within one-quarter mile, which is within present capability, and it would have the added advantage of being usable in all weather.

Improvement in the accuracy of the over-all system is expected with Transit II-A primarily because a digital clock carried aboard the satellite, will provide a more accurate time signal than the National Bureau of Standards time signal now being used.

Further requirement for improved accuracy in the system is better geodetic information. Knowledge of the shape of the earth and the location of its land masses is steadily improving as tracking of satellites becomes more accurate and two very accurate experiments in this connection are being prepared for the future. One is an Army experiment scheduled to be carried on the next Transit shot and the other is a NASA flashing light satellite which can be tracked from the ground.

Complete seaborne trials of the Transit system were initiated soon after the Transit II-A launch by the USS Observation Island, with prototype equipment.

Accuracy of these trials will be improved a week after launch, after the satellite is despun.

Instrumentation in the radiation measurement satellite consists primarily of two ion chambers, one for measuring X-ray radiation and the other for lyman-alpha band ultra-violet radiation.

Convair, IAM Settle; Other Talks Continue

Convair Division of General Dynamics and the International Association of Machinists last week reached a contract agreement involving 25,000 employes, but elsewhere strikes continued at Lockheed's Missiles and Space Division plants and at United Aircraft's Connecticut installations.

Negotiations were under way at Lockheed and United and a back-to-work movement of union and non-union production employes (AW June 20, p. 75) became increasingly evident.

The Convair-IAM settlement calls for a two-year contract for all hourly employes in IAM bargaining units at Convair's three California divisions: San Diego, Astronautics and Pomona. Agreement raises hourly wage rates four cents immediately and freezes a five cents per hour worth of past cost-of-living benefits into permanent base pay rates.

It also raises hourly wage rates by three more cents an hour and inaugurates a cost-of-living adjustment a year from the contract signing. Fringe benefits include a new program of extended layoff benefits of $50 a month for each year of service, up to a $500 maximum; raise in employes' pension payments for $1.75 to $2 per month for each year of service, and an increase in term life insurance benefits for retired employes from $500 to $1,000.

New agreement makes special provisions for Convair-San Diego workers at Holloman AFB, N. M., and Convair-Astronautics workers at Atlas intercontinental ballistic missile bases. It proposes an immediate pay raise of 54 cents per hour for top five factory labor grades and top four technician and office grades at the bases. Top wage rates would be $3.75 an hour under the new pact.

At Lockheed Missile and Space Division, the IAM turned down a company offer, reportedly similar to Convair's settlement, and resumed negotiations shortly after. Strike involves Lockheed's activities at Vandenberg AFB, Sunnyvale, Van Nuys and Santa Cruz.

Main stumbling block appeared to be the IAM's objection to Lockheed's insistence on its right to reclassify job descriptions. Company said that 76.4% of its day shift workers in San Francisco area plants had returned to work and that 61.5% were on the job at Van Nuys. Union countered by saying that production on Polaris submarine missiles and Midas, Samos and Discoverer satellites was shut down.

Meanwhile, a tentative agreement was reached between Lockheed and the IAM involving plants in Santa Monica and El Segundo, patterned after the recent United Auto Workers-Douglas settlement covering Long Beach, Calif., and Charlotte, N. C., facilities.

Bargaining resumed between Convair-San Diego and the Engineers and Architects Assn., after the union canceled the second of its one-day-a-week walkouts.

In Connecticut, the IAM and UAW resumed talks with United Aircraft's Pratt & Whitney, Sikorsky and Hamilton Standard divisions, but United said it appeared the talks would continue for some time, after issuing a statement contending that the unions have "lost the strike."

Production returnees at two of three Pratt & Whitney shifts late last week totaled 7,541 or 53% of the work force. At Hamilton Standard, 40% (1,251 workers) were on the job and Sikorsky has 31% (1,022) workers reporting for work. Picketing continued but there were few incidents, as had been the case earlier.

In Dallas, Tex., Federal Mediator Ted Morrow asked representatives of Chance Vought Aircraft and United Auto Workers Local 893 to meet with him separately. Contract expired Mar. 17 and latest series of negotiations broke off June 11. Since then, workers have walked off the job three times in one-day-a-week strikes, the last on June 21.

Union last week offered to submit demands to "any recognized arbiter" in the Dallas-Ft. Worth area, providing the arbiter will consider a plan based on comparison with other aircraft company contracts. Since Chance Vought previously has contended negotiations must be geared to local standards, it is expected to turn down the proposal. Company proposal which was rejected called for a general pay raise of five cents an hour now, and a deferred increase of seven cents next year, plus fringe benefits.

Variable Thrust Rocket Applicable to Drones

McGregor, Tex.—Variable thrust long-duration solid-propellant rocket motor especially applicable for use on supersonic high-altitude target drones has been developed by North American Aviation's Rocketdyne solid propulsion operations here.

As an illustration to the new motor's capabilities, it could be preset to the desired sustained thrust level. A nominal boost burn time of 45 sec. would propel the drone to 70,000 ft. from a launch speed of Mach 0.7, the unit would be boosted to approximately Mach 2 and be able to cruise at this speed for 10 min.

Changes in thrust level are taken care of by the variable area nozzle, so that in cases where the drone launch plane was flying at lower or higher speeds or at different altitudes, the boost phases could be set for longer or shorter durations depending upon the desired program.

For lowest-cost, maximum performance, the proposed propulsion system would use an ammonium nitrate propellant, similar to that employed on the Temco Teal drone. This system employed a boost disk of fast-burning solid propellant bonded to the slower-burning sustaining charge. The variable area nozzle eliminates need for the dual-thrust propellant charge and makes it possible to program the flight for a variety of missions, speeds and altitudes in the field.

House Group Urges Bigger Lunar Effort

By Ford Eastman

Washington – Greater emphasis should be placed now on mapping the moon and learning on earth how to build and operate lunar facilities, the House Science and Astronautics Committee said last week.

"Despite the fact that work on large-thrust boosters capable of placing large payloads on the moon is receiving a priority commensurate with the established requirement," the committee's report warned, "research and development required to operate effectively in a lunar environment is not proceeding with the same urgency."

To achieve any degree of success with a manned landing on the moon, the report said, a multiphase program of preparation is needed. This should include not only lunar mapping and analysis but also a construction capability and environmental training, which should keep pace with development of boosters.

"If such a program is begun immediately," the report said, "it is considered that the lunar base could be available within the next decade so as to coincide with the availability date of the necessary transport system."

The committee suggested that the Army Corps of Engineers lunar analysis and mapping program (LAMP) be integrated with Air Force's complementary mapping program and reviewed by the National Aeronautics and Space Administration to see what funding would be available. It is estimated that $7.8 million would be needed to complete the program.

Work also should be started on a Lunar Construction Research Facility to solve engineering and environmental problems connected with building a base and living and operating on the moon, the committee said. Such a facility would cost an estimated $6.5 million, not including special instrumentation and research apparatus, and require three years to build.

Project LAMP

Project LAMP, a four phase program, is currently in the first stage and funded through 1960. This stage covers preparation of a map of 1:5,000,000 scale of the visible side of the moon, using currently available photographs, radar reflections and other material.

Principal result of this effort, the report said, would be the production of a horizontal control network on the moon through the use of a large digital computer. This survey process is known as selenodesy. With this selenodetic grid, the craters, maria and other known features of the lunar surface can be located on a map more accurately than before.

Stage II will include balloon photography and radio interrogation. Also during this phase, requirements for a lunar orbiting system will be determined.

This stage would cost $800,000 and require 12 to 18 months to execute.

Lunar Orbit

Stages III and IV would carry the program to the point of readiness to launch a payload to orbit the moon. The orbiting system would be designed at a cost of $2 million and a total time of 12 months. Stage IV, the hardware would be built and tested. This would require $5 million and a period of 12 months.

The over-all objectives of the LAMP project, the report said, are:

- "**To make a rapid and accurate** (plus or minus 300 ft.) three-dimensional survey of the entire lunar surface.
- "**To determine the characteristics** of the surface of the moon by multiple-frequency electromagnetic interrogation.
- "**To produce topographic-terrain** and surface-property maps to be used in selecting scientific landing sites on the moon."

Orbiting Problems Described

Three techniques for making a rapid and accurate three-dimensional survey of the entire lunar surface, including the back side, are radar, television and camera. But a prerequisite to the operational use of any of these is the solution of propulsion, guidance and control problems to satisfy the following specifications:

- "**The instrument system** must be put into polar orbit of small eccentricity around the moon at an altitude of between 50 and 100 mi. above the lunar surface.
- "**The instrument package** must be maintained in this orbit for as long as is necessary to cover the entire lunar surface. The time required ranges from one to several lunar days [a lunar day is approximately 28 earth days].
- "**Direction and attitude** stabilization must provide continuous three-axis control for the direction of the mapping."

The radar system could become operational at an earlier date than the other two, the report said. While more complex than the others, it has a potential weight advantage and consists of a radar altimeter for continuously profiling the terrain beneath the orbiting vehicle, a multiple-frequency surface interrogator and passive distance-measuring devices. Its main problem is accuracy.

The television system, in addition to employing components in the radar system, would be used to get stereoscopic coverage of the moon's surface as well as for obtaining star and earth positional data in order to preserve the geometric relationship necessary for the stereophoto mapping.

Basically, the television system would take pictures of the moon and transmit them to earth. To orient these pictures, another TV camera in the vehicle would take and transmit a picture of the stars at the same time in order to determine proper orientation.

The third system would combine the components of the radar system with a high resolution nadir camera and three horizon cameras. Stero coverage would be obtained by overlapping exposures taken with the nadir camera. The synchronized horizon cameras would provide simultaneous exposures from which the direction angles of the geometric nadir camera could be obtained.

From photogrammetric evaluation of the pictures and from altimeter measurement, the report said, a selenodetic coordinate system could be derived. In addition to the coordinates, a lunar datum, a polar reference and the rotational rate could be established.

Camera system would provide not only a higher degree of accuracy than the other two systems, but also better resolution without jeopardizing the system's usefulness for mapping, the report said.

As for establishing an outpost on the moon, "every task and every operation to be accomplished must be thoroughly planned and rehearsed in advance on the earth," the committee concluded. "The best way to accomplish this is by the use of a large-scale environmental simulation chamber which will provide research and training in this respect."

Simulated Conditions

No program is being undertaken today, either by the Defense Department or NASA, to study simulated conditions, which is necessary to a successful program of lunar exploration, the report said. The Engineer Research and Development Laboratories of the Corps of Engineers has done a preliminary design study of a lunar construction research facility.

Although the report did not mention them, a number of similar studies have been done by industry.

The Engineers' environmental chamber is the principal technical component of the facility, consisting of a steel sphere equipped with a vacuum system, a simulated solar radiation source and liquid nitrogen heat sinks.

NORD AVIATION SS-12 is a larger, longer-range anti-tank missile than the company's earlier SS-10 and SS-11. Launched here from the ground, the 6 ft., 150 lb. missile can also be fired from a tank or aircraft. It can be controlled over its 4 mi. range either by wire or radio link. SS-12 can be equipped with a nuclear warhead, broadening its application beyond the tank killer role. Production is expected to begin in about 18 months. U. S. Army and North Atlantic Treaty Organization ground forces are potential customers; a U. S. military group was in France earlier this month inspecting the missile.

Army, Marines Conduct Anti-Tank Evaluations

Washington—The Army and Marine Corps currently are evaluating three foreign missiles in long-range programs to provide modern, portable weapons for field use against tanks.

Industry interest in European anti-tank weapons was highlighted last week when General Electric's Missile and Space Vehicle Department became the third U. S. firm to acquire license rights for production of foreign anti-tank rockets.

Army Ordnance Missile Command has just completed tests of French SS-11 and Entac and German Cobra missiles at Redstone Arsenal, and the Army is evaluating results. Cobra also is under study by the Marine Corps Landing Force Development Center at Camp Pendleton, Calif.

Army began buying foreign anti-tank missiles last year following cancellation late in 1958 of the U. S.-built Dart. The Nord SS-10 was adopted as standard equipment for field troops and has been issued to Seventh and Eighth Armies, Strategic Army Corps.

GE last week reported it has signed an option agreement with Nord Aviation to produce SS-10 and SS-11 in this country. The 10-year license agreement automatically goes in force if GE receives a U. S. military order for either missile. Nord and GE will pool information on new developments either firm produces in their programs, and Nord will help GE set up production.

West German Army ordered 25,000 SS-11 missiles last month, and a large U. S. order probably would tax production facilities at Nord.

Two other anti-tank weapons, British Vigilant and Swiss Mosquito, were not in the recent Army evaluation but are considered part of the long range competition to supplement or replace SS-10. Vigilant was demonstrated last year at Redstone, but did not undergo vibration, heat and shock tests which the Army gave the Cobra, SS-11 and Entac.

The Cobra is a development of Boelkow-Entwicklungen of Munich. Production rights for this missile are held by Daystrom Corp. Clevite Corp. Ordnance Division holds production rights for Vigilant, a development of Vickers-Armstrongs, Ltd. License to build Mosquito in U. S. is under negotiation. Mosquito was developed by Contraves AG.

Entac is the only missile evaluated which is not now in quantity production. Under study for the past eight years, Entac is a project of DEFA, the French government arsenal system.

Foreign anti-tank missiles being evaluated by U. S. are similar in wire guidance, simplicity of launch, light weight and lethality (AW Sept. 9, 1957, p. 28). All are fin-stabilized and received commands through manual movement of a small control stick.

Cobra under consideration is believed to be a further development of Cobra 4 (AW June 30, 1958), which weighs 23.2 lb. Range of Cobra 4 is about 6,250 ft.

SS-11 is said to double the one-mile range of SS-10, although in doing so it nearly doubles the weight of the 33-lb. Model 10. Vigilant also has one-mile range. Its 40-lb. field package contains a missile and spotting binoculars.

Entac reportedly has same characteristics as SS-10, but is said to be 18 months to two years away from quantity production.

NASA Appropriations Increased by Senate

Washington—Senate voted National Aeronautics and Space Administration a $965 million budget for fiscal 1961 last week—$50 million more than the Administration requested and $89 million more than the House approved.

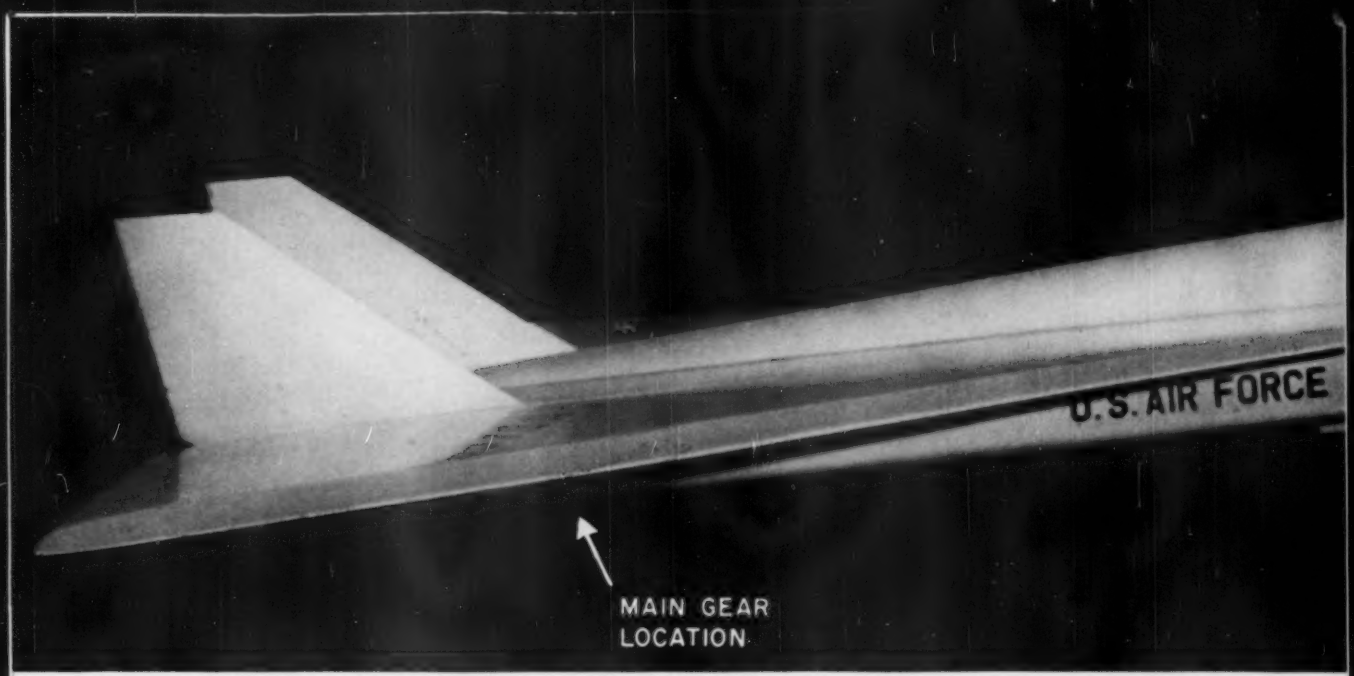
The Senate restored a $19 million cut made by the House in NASA research and development funds and added another $50 million.

Differences in the budgets voted NASA by the House and Senate will be decided by a joint conference committee. They are:

- **Research and development,** $602 million approved by the House and $671 million by the Senate.
- **Construction and equipment,** $107 million approved by the House and $123 million by the Senate.
- **Salaries and expenses,** $166 million approved by the House and $171 million by the Senate.

Other Fiscal 1961 budgets approved:

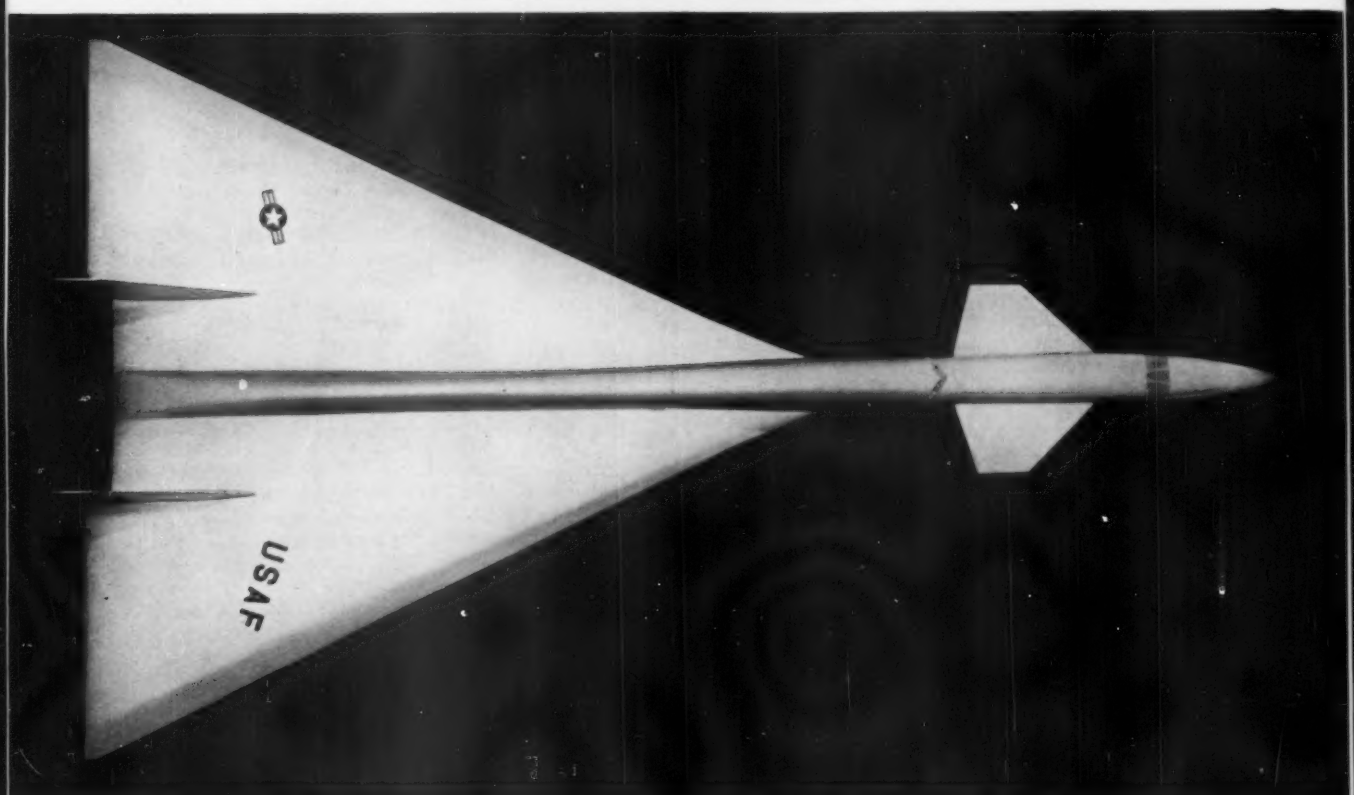
- **Federal Aviation Agency.** The $709 million approved by the Senate was $3.9 million below the Administration request, but $37 million more than approved by the House. The Senate added $15.6 million for expenses and $21.5 million for establishment of air navigation facilities to the amounts approved by the House.
- **Civil Aeronautics Board.** The $7.5 million voted by the Senate for salaries and expenses was $100,000 below the Administration request, but $215,000 above the House figure.
- **National Science Foundation.** The Senate approved the full $192 million requested. The House voted a reduction of $32 million.

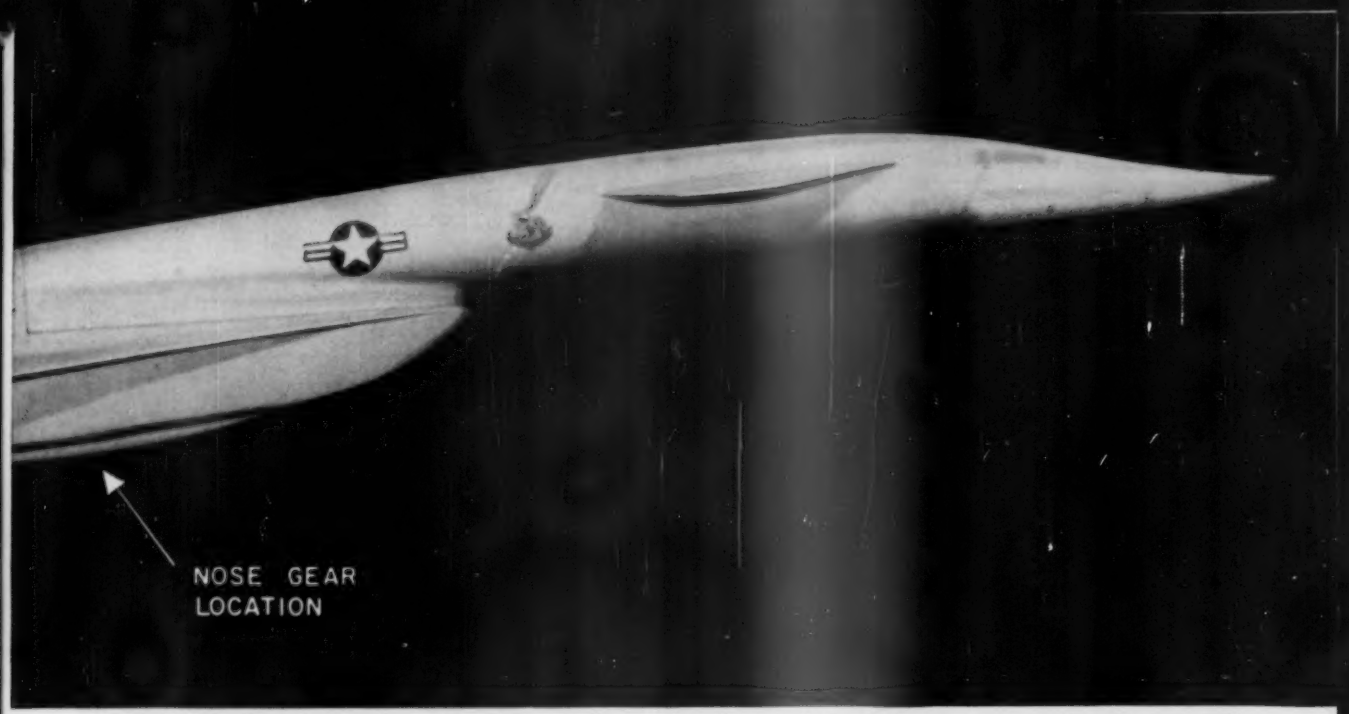


Scale model of the Air Force-North American B-70 Mach 3 bomber shows the abrupt changes in camber used on the aircraft's wing. This technique adjusts the surface pressures at Mach 3.0 so that an elliptical loading pattern exists in both the spanwise and fore and aft directions. Elliptical loading is a requirement for high aerodynamic efficiency. Multi-wheel units are used on the nose and main landing gear

First Photos of B-70 Model Show Design Features for

North American B-70 has been proposed as the first nuclear-powered aircraft by the company and some Air Force officials. Reactor would be located just forward of the two vertical tail surfaces at the rear of the airframe. Crew sits about 100 ft. forward of this point, ahead of the canard control surface, so that the shielding problem could be handled within the current state-of-the-art.





on the B-70. All of the wheels in these units are the same size to reduce the magnitude of the spare parts and maintenance problems. Canard control surface at the nose is more effective than tail controls on a B-70 type aircraft because it can be located farther from the center of gravity, and its trim lift force is up rather than down, which serves to increase the airplane's operational lift-drag ratio.

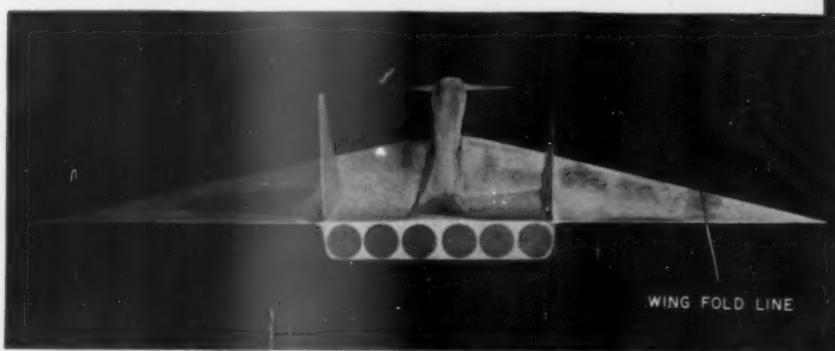
Mach 3 Cruise

Efficient long range cruise at supersonic speeds became feasible during the last five years when great improvements were made in the aerodynamic state-of-the-art and lift-drag ratios attainable above Mach 1.0 were more than doubled. The North American B-70 is the first aircraft designed to take advantage of this large reservoir of new knowledge which was gained through experimentation and theoretical work by the Air Force, National Aeronautics and Space Administration, universities and industry.

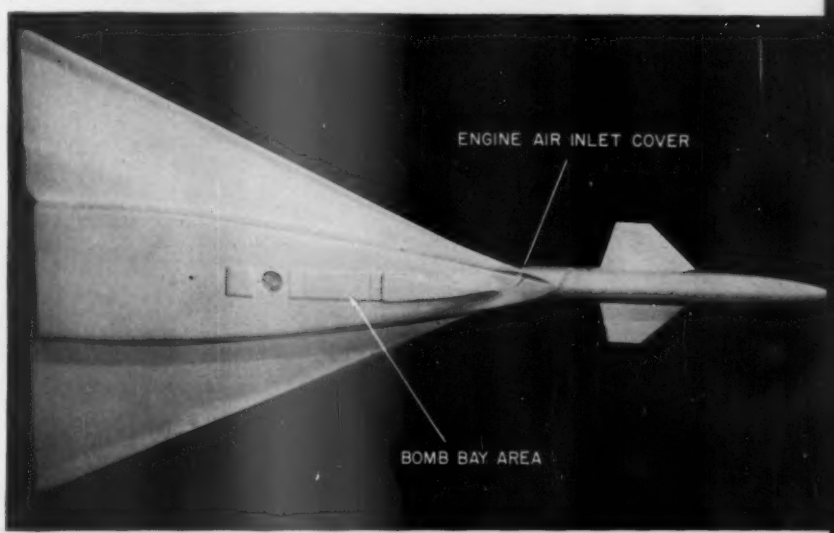
Two design features which are essential to the long range performance of the B-70 grew out of this research in the last five years. One of them is the use of wing tips which can be turned down at high speeds and increase lift pressure under the wing by intercepting flow fields from the fuselage. The other essential aerodynamic design feature is an almost glass-smooth outer surface to keep friction drag low.

Idea of improving lift-drag ratio by turning the wing tips down originated with A. J. Eggers, Jr., of NASA's Ames Research Center. North American incorporated the idea into the B-70 by using a large external air duct for the engines and shaping it so that it would direct a very strong flow at the turned down wing tips. Lift is increased because the wing tips turn this large air flow downward.

Improved manufacturing methods and sandwich skin have made it possible to build aircraft with almost glass-smooth surfaces, but when they enter service they will require a new order of maintenance care.



Slight area rule of B-70 fuselage is visible above. Wing tips fold down to improve lift-drag ratio at Mach 3.0 cruise speed. Variable area nozzles for the General Electric J93 engines in the B-70 are so large they cover almost one-third of the wing span in their six-abreast mounting. Large engine air duct (below) houses the bomb bay and landing gear on the B-70. Duct inlet on model is covered because it is still classified. Hole in middle of duct is for model support stand.



U. S. NAVY'S anti-submarine Asroc missile is seen ready for loading and firing from launcher during evaluation test.

Navy Plans to Install Asroc on 150 Ships

By Edward H. Kolcum

Key West, Fla.—Navy is completing fleet test of its Asroc rocket-boosted anti-submarine weapon system and plans to install the system on 150 cruisers and destroyers over the next several years.

Coupled with a sonar detection system, Asroc weapon is fired from surface ships with a solid propellant booster. It is designed to provide a rapid method of detecting and evaluating high performance submarines and of destroying the targets quickly. Navy plans to install the system on 150 ships scheduled for overhaul in the next several years in the fleet modernization program.

ROCKET booster of Asroc, seen being fired from USS Norfolk, separates in flight and a parachute lowers torpedo into the water to seek out its submerged target.

Missile Payload

Payload of the Asroc missile is either a torpedo or depth charge boosted in a ballistic trajectory to the area of a submarine target. The torpedo enters the water and conducts a circling search with its acoustic homing equipment. Landing shock is attenuated by a 6 ft. parachute which opens on the terminal leg of the flight. Depth charge configuration, somewhat shorter than the 15 ft. length of the torpedo system, has not been fleet-tested. It will not incorporate a braking system.

Asroc uses a sonar detection system which is compatible with the weapon

system and permits firing of the weapon shortly after target acquisition. Sonar can use a "bottom bounce" technique in which sonar beams are alternately reflected from the floor and surface of the ocean.

In first public firing of the system last week, four torpedoes were launched over ranges up to 3,700 yards against the nuclear submarine USS Skate. Firing ship was the destroyer leader USS Norfolk, which has conducted the fleet test program since it was started in March. Three rounds reportedly resulted in probable kills.

After the demonstration, a member of the Navy Operational Test and Evaluation Force said Asroc gives the ASW ship a weapons system edge because it can kill a sub before the sub reaches effective torpedo attack range.

Asroc System

The system consists of the weapon, launcher, detection sonar and digital fire control computer. It was developed by the Naval Ordnance Test Station, which directs the development program. Minneapolis-Honeywell Regulator Co.'s Ordnance Division is prime contractor. Navy estimates the development program will cost $65 million, and cost of each destroyer installation will be $1.8 million.

In evaluation launches to date, the missile system has consisted of a General Electric Mk. 44 acoustic homing torpedo approximately 100 in. long. Solid rocket motor, about 2 ft. long, is separated from payload by 4 ft. hinged airframe housing range control mechanism. Range for the weapon is set by a timer—the digital computer feeds instructions before launch on time to eject the motor. After the motor is separated, it continues to burn unless it has been fired to maximum trajectory, and therefore, burns out at separation.

Payload and airframe are unpowered for remainder of the ballistic trajectory. There are no guidance changes after launch. In the terminal phase, a steel band holding the airframe together is broken by an explosive bolt. The airframe peels off and the parachute deploys.

The chute is released when the torpedo hits the water.

The booster has a lift-off thrust of 11,000 lb. and is under production at the Naval Propellant Plant, Indian Head, Md. The casing is made by Minneapolis-Honeywell, which produces all weapon parts except the torpedo payload.

Booster and airframe are stabilized by four 1½-ft. fins.

Mk. 44 torpedo payload is a conventional weapon with high explosive warhead. Its propulsion batteries are energized by sea water. Alternate payload is NOTS-Honeywell Mk. 17 depth charge, which can carry nuclear warhead.

Mark 112 Model 0 launcher system is built by Universal Match Corp. Armament Division under Honeywell subcontract. Launcher is made up of eight enclosed cells in four vertical banks. Battery trains on target as a unit, and each bank of two missiles elevates independent of the others. Guide rails extended from each cell as weather doors open about 30 sec. prior to launch. Constant temperature is maintained inside cells by circulation of coolant or antifreeze in tube banks.

Launcher will fit precisely over 3"/54 cal. and 3"/70 cal. mounts. Gun mount drive mechanisms are replaced for Asroc.

Sonar used in Asroc is low-frequency, high-energy SQS-23 developed under a separate contract by Sangamo Electric Co.

Navy will not discuss range of Asroc weapon or sonar but says that unlike previous sonar-torpedo combinations, Asroc is compatable. This means the rocket can be launched very soon after target acquisition at maximum sonar range. Use of low-frequency sonar has increased detection ranges because of an ability to "bottom bounce" and because its long wave lengths are less affected by the thermal gradient. Bottom bounce sonar beams reflect off the floor of the ocean to the surface and back to the floor. Signals acquired over ranges possible with this technique are not accurate enough for an attack, but they aid in early warning.

Asroc will incorporate first shipboard use of digital fire control computer. The system was developed by General Precision, Inc., Librascope Division, to establish target course, range and speed and to compute the ballistic intercept path. Called the Mk. III fire control group, the computer feeds elevation and train information to the launcher and motor ejection time to the missile.

In the tests conducted here last week, ranges were 2,600 and 2,700 yards for first two shots fired separately, and 3,700 yards for third and fourth rounds fired in salvo. Exercise warheads contained graph tape to record a statistical summary on record paper or torpedo course and speed and proximity to target. First two torpedoes were instrumented to stop batteries at range of 200 yards from target; last two were fired to impact Skate.

Because of search feature in Mk. 44 torpedo, it can splash "several hundred yards from the target and have an excellent opportunity to hit the target.

Development of Asroc began in 1956 and was accelerated in 1957 along with a general buildup of ASW in the Navy. Ballistic curves were computed from static and moving platform tests at NOTS China Lake facility, from airplane drops off San Clemente Island, Calif. and in water firings at Morris Dam, Calif.

The Navy believes Asroc represents a close approach to the "wooden bomb" concept because the system requires minimum shipboard maintenance. It also promises growth potential in range and payload weight. Torpedo configuration weighs 1,000 lb.

Destroyer USS Perry and the Norfolk are the only operational ships currently equipped with Asroc. Both have stern mounts but there is no apparent bar to bow mounts, since a slight maneuver will unmask any target blocked by ship structure. Norfolk can fire from all angles except 45 deg. to either side of its bow.

Soviet View of X-15

Moscow—North American X-15 rocket research plane "is obviously intended to replace the U-2" as a spy plane and the National Aeronautics and Space Administration is "used to camouflage aerial espionage," the Soviet defense ministry newspaper Red Star said.

Red Star said NASA is "now strenuously engaged in testing the new 'super-altitude' X-15," and said the aircraft, like the U-2, is referred to as a "special-purpose aircraft."

House Restores Funds To Military Aid Budget

Washington—House has restored half of the $400 million cut by its appropriations committee from the $2 billion Fiscal 1961 military aid budget request, but efforts to add $50 million to defense support funds failed.

Appropriations committee cut the military assistance budget to $1.6 billion (AW June 20, p. 82), but the House increased this to $1.8 billion before sending the appropriation to the Senate.

Administration asked $724 million to bolster the economies of nations supporting large military forces, but the committee cut this to $600. An unsuccessful attempt was made to add $50 million.

Total foreign aid budget approved by the House was $3.58 billion, a substantial reduction from the $4.17 billion Administration request.

Senate Appropriations Committee concluded hearings on the foreign aid budget last week, and the group is scheduled to complete work on the appropriation and report its recommendations to the Senate this week.

Air Force Orders Titan II Improvements

Washington—Award of an $8 million contract for the more powerful Martin Titan II intercontinental missile last week marked the beginning of a $400 million Titan improvement program that drew congressional criticism earlier this year because it stretches the missile's development into the period when the cheaper solid fuel Minuteman will be available.

Titan II will have more than 480,000 lb. of thrust, compared with about 380,000 lb. for Titan I. It will use storable fuels, giving it in-solo launch capability and cutting reaction time, and it will use the AC Spark Plug-Massachusetts Institute of Technology all-inertial guidance system instead of Titan I's Bell Telephone Laboratories-Remington Rand radio command-inertial system.

All these improvements were to have been made in Titan eventually. Decision to introduce them all at once rather than step by step led to the so-called Titan II program.

Witness Testimony

Testimony by Air Force witnesses before the House Armed Services Appropriations Subcommittee earlier this year indicated that postponing of later Titan production, and consequently delaying the time when production costs would have to be paid, was a big factor in deciding to introduce Titan improvements in this way.

Chairman George Mahon (D.-Tex.) suggested that since the improvement program would push operational dates of the seventh through 14th Titan squadrons into the 1962-63 period, it would be preferable to buy larger quantities of Minuteman, which he said are "cheaper and easier to handle." USAF witnesses were divided on the Titan decision, but those who favored it said the heavier Titans are needed because "the heavier weight of the warhead has special uses" that Minuteman could not handle (AW Apr. 4, p. 34). The funds were later approved.

Longer Titan II

Titan II will be almost 10 ft. longer than the Titan I.

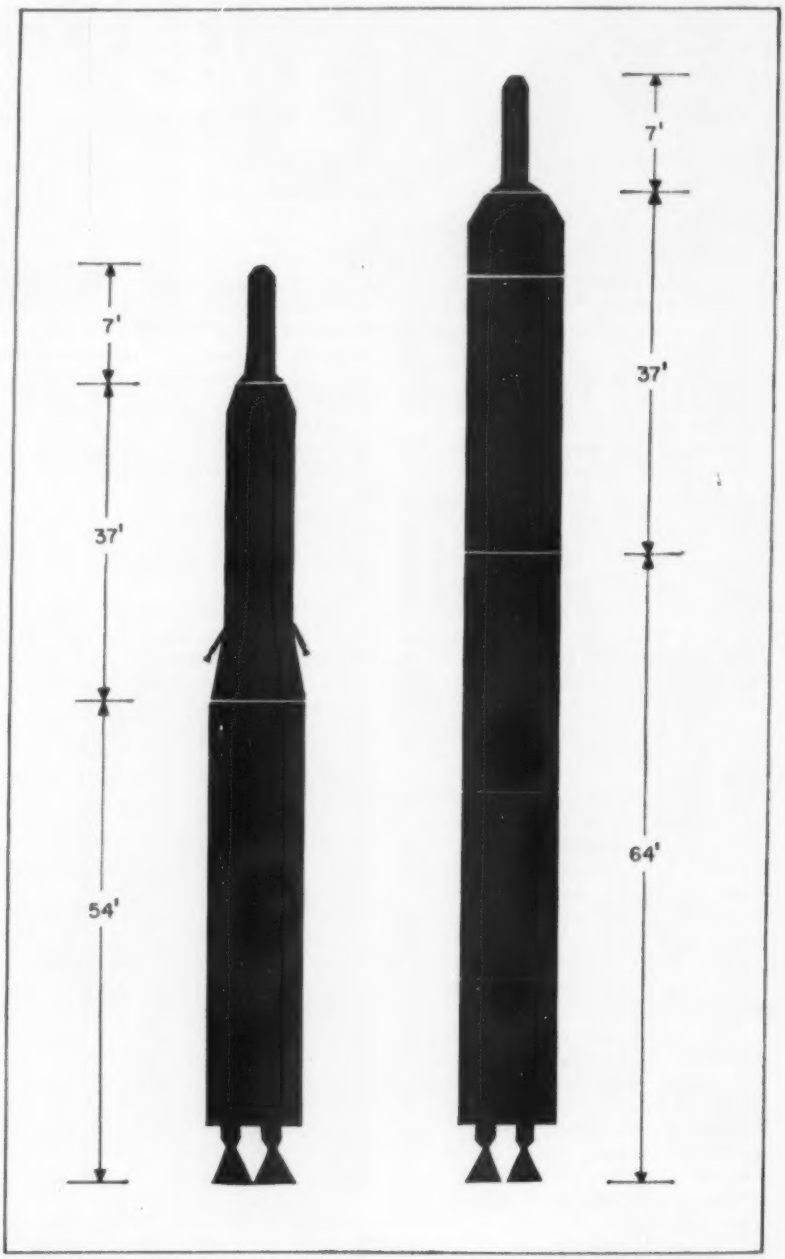
The diameter of the upper stage is increased from eight feet to the 10-ft. diameter of the first stage, and length of the first stage is increased from 57 to about 67 ft. The two first stage Aerojet engines are uprated from a total of about 300,000 lb. to more than 400,000 lb., and the Aerojet second stage engine is uprated slightly over the 80,000 lb. thrust level of Titan I's second stage engine.

Two JATO bottles are used in Titan I to produce enough gravity force to keep propellants at the lower end of the second stage tanks and also to separate the stages far enough so that ignition of the engine won't rupture the upper tank bulkhead of stage one. These are eliminated in Titan II. Verniers are no longer visible in Titan II.

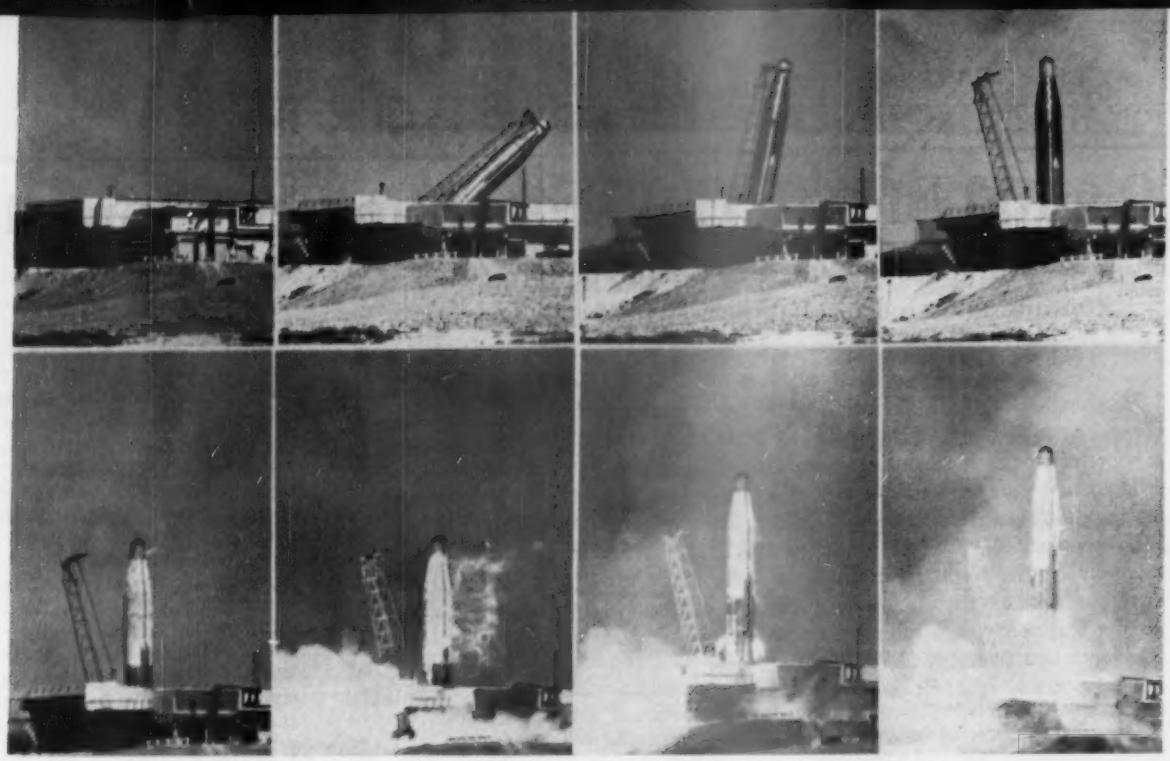
First Stage Modification

Titan II first stage is modified to allow second stage ignition before the stages are separated, permitting more even acceleration from launch to burnout.

Titan Is will be used to flight test the all-inertial guidance over the Atlantic Missile Range and modified Titan Is will be used for silo launching tests from Vandenberg AFB., beginning this fall (AW June 13, p. 23). Titan I will become operational next year as the SM-68. Titan II will be designated SM-68B.



ARTIST'S CONCEPTION of USAF-Martin Titan II shows longer first stage than Titan I, wider diameter in second stage, approximately 10 ft. increase in over-all length.



First Photos Show Atlas Being Fired From Coffin

Atlas intercontinental ballistic missile in operational configuration is fired from coffin launcher during a SAC training launch at Vandenberg. Photos were taken over a 15-min. span. Missile's Mark 2 heat-sink re-entry vehicle landed 5,000 mi. down Pacific Missile Range.

German Glider Wins World Championship

Butzweiler, Germany—Germany's Heinz Huth racked up 5,619.1 points with his Kaiser KA6-B glider to win the standard class competition in the Eighth World Gliding Championship competition here.

Argentine entry Rodolpho Hossinger won the open class event with 5,102.9 points, flying a Slingsby Skylark.

Polish pilots Edward Makula and Jerzy Popiel, flying Polish SZD Zefirs, came in second and third in the standard class with 5,079.1 and 5,020.7 points, respectively. Brazil's George Muench flew his KA6-B to second place in the open class with 5,237.8 points and third place was taken by Poland's Adam Witek in a SZD Foka, scoring 5,201.9 points.

Weather limited flying to six days out of the 14 scheduled. Total of more than 43,000 mi. was flown during competition in all events.

The U. S. team, captained by Paul A. Schweizer, placed low in competition. Paul Bikle, of National Aeronautics and Space Administration, took 12th place in the standard class; Richard H. Johnson and Richard E. Schreder took 15th and 16th places in open class.

U-2 Value Discounted

Bucharest—Soviet Premier Khrushchev told a Rumanian Communist Party congress last week that information obtained by the U. S. through flights of the Lockheed U-2 aircraft was "of no importance" because it came from areas where there were no strategic rocket bases.

"We know that two or three years ago they photographed the areas of the proving ground where we conduct experimental rocket launchings," Khrushchev said. "It was rocket weapon testing grounds that they photographed, not strategic rocket bases."

News Digest

Five Lockheed JetStars have been ordered by U. S. Air Force for use by Airways and Air Communications Service (AACS) in making in-flight inspections of military navigation aids. Four-jet UCX aircraft will be delivered in mid-1961.

Maj. Gen. John S. Bragdon, retired Army engineer, was confirmed by the Senate last week for appointment to the Civil Aeronautics Board by a 73 to 18 vote. Opposition centered around naming of another general to a high civilian post. Bragdon, 67, has been a White House public works planning aide for almost six years. Gen. Bragdon was a West Point classmate of President Eisenhower.

Nike-Zeus test vehicle booster exploded at White Sands Missile Range last week during the first launch attempt from an unvented cell. Underground concrete emplacement was damaged slightly, but cell instrumentation functioned through the explosion. Army said this was first failure at launch in eight firings of Zeus in the development program started at White Sands last August.

S. A. Lavochkin, 59, Russian aircraft designer and builder of the first Soviet airplane to fly at sonic speed, died June 9. Lavochkin designed a number of World War II fighters, including the LaGG-3 La-5, La-7 and La-9, as well as the La-17 turbojet fighter.

Full-scale mockup of Bell HU-1D helicopter has been examined by U. S. Army-USAF development engineering team at company's Hurst, Tex., plant. Hu-1D features an enlarged cabin, to carry 12 fully-equipped soldiers plus two crew members, compared with earlier HU-1A and B, which can carry nine passengers.

Air Force is conducting a high priority inspection of all Bomarc missiles after blaming a bursting high pressure helium bottle for the fire that destroyed a nuclear-armed Bomarc June 7 at McGuire AFB. Helium bottle is located between fuel tanks of the missile's ramjet engines.

Capital Bids to Hold Stockholder Support

Airline urges shareholders to rebuff employe group; continuing cash drain hampers struggle for recovery.

By L. L. Doty

Washington—Capital Airlines, shaken by mounting losses and traffic declines, opened a major proxy battle last week in its latest attempt to hold the support of stockholders during its current fiscal plight.

In its first proxy solicitation since Vickers-Armstrongs, Ltd.—British manufacturer of the carrier's fleet of Viscounts—brought foreclosure action against the company (AW Apr. 18, p. 38), Capital urged stockholders to repudiate attempts by the Capital Shareholders Assn. to oust the present board of directors. The association, consisting mainly of employe-stockholders, mailed proxies four weeks ago calling for a special meeting at which it hoped to select new management (AW June 6, p. 41).

The internal fight for control of the company is overshadowed only by the imminent threat of bankruptcy as well as the dismal financial situation in which the airline finds itself. Capital is slated to answer the Vickers complaint in a U.S. district court in New York today unless it receives another postponement, which would be the fourth granted since Vickers first filed its petition.

Meanwhile, the airline has been seriously hampered in its fight for recovery by a continuing drain on its cash position. First quarter losses climbed to $5.4 million, heaviest for any three-month period in the company's history.

In April, the company reported a modest profit of $57,000, a figure far short of the $700,000 net profit originally forecast in the airline's budget. Actually, daily cumulative figures during the month indicated the airline was headed for a $406,000 April loss, but bookkeeping adjustments converted the loss trend into the black figure.

Traffic From Strikes

Again in May, traditionally one of the airline's best revenue producing months, losses piled up to an estimated $1.1 million. The trend may be reversed in June because of the labor strikes against competitors which forced diversion of traffic to Capital. During the first 10 days of the month, however, before the airline began to reap the benefits of the strikes, an approximate $200,000 loss had already been accumulated.

Because of the strikes, chances are strong that the airline may report the $200,000 net profit which it originally forecast for June. Historically, Capital's traffic during July and August normally slides downward from June's level so that, unless traffic volumes are still artificially sustained by the strikes, further losses can be expected.

System-wide load factor in May was 52.3%, compared with a trunkline industry average of 59%. According to Civil Aeronautics Board reports, Capital's share in at least six of its leading markets has been steadily whittled down by its competitors. Among these markets are such high-density routes as Chicago-New York, Washington-Chicago and Detroit-New York.

New Service

Capital's new service to the Miami resort area has not developed progressively, and this lucrative market has consistently failed in recent months to rank among the top 10 of the carrier's leading markets, even during the heavy winter vacation season. One bright spot has been a marked improvement in Capital's system-wide operations performance. Latest figures show an 81% on-time performance factor for May, compared with 77.8% for the same period last year.

The financial situation, compounded by a newly-adopted stringent budget policy that is forcing heavy personnel cutbacks, has served to demoralize the company to a serious degree. The reduction in personnel complements, largest single cutback ever undertaken by Capital, has hit all levels and has eliminated several high-ranking second echelon officials with over 20 years experience with Capital.

Several changes have been made in the structure of the airline's management, but, following the realignment (AW May 30, p. 41), total staff reduction at this level amounted to only one officer. Present executive management staff now totals 17, compared with the seven in office when David H. Baker assumed the presidency in Aug., 1958.

Thus far, there has been no evidence that the airline has developed a firm plan for recovery that is likely to ease any of the pressure from its creditors. Chief block lies in the carrier's inability to generate net earnings, a factor that bars the way to a refinancing program. There is no sign of relief from merger. Since the financial crisis began, the airline has received no formal invitations to talk merger, although rumors have been rampant to the contrary.

The airline withdrew its request for subsidy on grounds that a forthcoming rate increase would help reduce deficits (AW June 6, p. 41). However, in its withdrawn petition, the airline asked for a subsidy totaling $12.9 million to cover estimated losses forecast for the 12 months ending Mar. 15, 1961. If this figure still stands, the airline will end this period with a loss of about $7 million, assuming that the 5% rate increase approved by the CAB (see p. 41) boosts the carrier's passenger revenues by some $6 million.

Another issue of growing importance is the payment of interest on the 4¼% convertible subordinated debentures due July 1. Before this interest can be paid, Capital must seek and obtain permission from chattel mortgage holders. Failure to pay interest on these notes could result in a small minority of debenture holders taking action against the airline.

New Chairman

Thomas D. Neelands, recently named chairman of the board (AW May 30, p. 41), has assumed responsibility for developing a financial program and establishing policy lines along which the company will operate during the crisis.

Neelands now holds the unified support of the board of directors, although it is still sharply split into two bitterly opposed factions. However, as previously pointed out by AVIATION WEEK (AW June 13, p. 40), the balance of power within the board has swung heavily behind Baker and his group after several unsuccessful attempts to oust him were made by the anti-Baker faction. Chances are now strong that he will retain this position unless the Capital Shareholders Assn. gains control of the company.

There are now 14 members on the

board, nine of whom were members at the time Baker took over as president. There are five Board members on the powerful executive committee, three of whom owned no Capital stock as of June 1, although one of the three, Gordon Y. Billard, who heads the Debenture Protective Committee (AW June 13, p. 40), owns $70,000 principal amount of debentures.

Neelands is one of the three who held no stock as of June 1. Arthur Kroeger, chairman of the executive committee, held 1,000 shares as of that date. Charles Murchison, who was recently removed as chairman of the executive committee, held approximately 80,500 shares of common stock as of June 1.

In its letter to shareholders urging proxy support, the airline stated that it had been holding meetings with Vickers in exploratory attempts to work out existing problems. It termed these negotiations as ". . . most delicate, requiring tactful and skillful handling . . ." and added:

"The intrusion at this time of the so-called Capital Shareholders Association and its efforts to remove the Board which is conducting the negotiations has, in our opinion, been most injurious and detrimental to the best interests of Capital Airlines, its shareholders, and the very employes who make up the bulk of the association's members. The timing of its bid to change control of Capital could not have been worse."

The letter, which was signed by Baker, pointed out that 95% of the Shareholder Assn.'s members are employes owning an average of less than 10 shares of stock each. It charged that the association's program was conceived and pursued by the eight members of the association's executive committee, all of whom are employe-pilots owning a combined total of 260 shares of stock.

'No Suggestion'

The letter charged that "the association has come forth with no suggestions, no scheme, no plan to increase revenues and take care of the $33,800,000 debt. Their approach is negative."

It warned that the association's proxy "relates not alone to the calling of a special meeting to remove the board. The proxy form is so drawn that any shareholder who signs it may thereby appoint three members of the association's Executive Committee his attorneys to 'participate in any legal proceedings to which Capital Airlines, Inc. is or may become a party' of the kind described in the proxy form.

"We earnestly suggest that you see your attorney before you sign the Association's proxy form and commit yourself to participation in litigation in which you 'will be bound by any judgments,'" Capital said.

CAB Launches an Investigation Of Airline Mutual Aid Agreement

Washington—Airline plans to expand the scope of the mutual aid pact established to help strike-bound carriers triggered a Civil Aeronautics Board investigation of the agreement last week.

CAB said it decided to investigate the pact when Braniff, National, Continental and Northwest Airlines asked to be included and when changes were proposed in the rules under which strike payments are made. The original pact was approved by the Board a year ago.

"It also appears likely that, although the pact will expire in a few months, [Oct. 20] the principle of mutual aid is intended to become a long-term feature of labor management relations in the industry," the Board said. "The inclusion of new members at this time lends support to this conclusion. Most important, the parties have now experienced more than a year of operations under the pact, during which it was applied to four strikes. There should therefore be available for Board consideration valuable factual data, most of which were not ascertainable at the time of the previous proceeding."

A need to determine the extent of airline development of long-term mutual labor relations arrangements also was cited by the CAB, which noted that material obtained from the files of the Air Transport Assn. under a current Board investigation of that organization indicates a need for a full hearing on the mutual aid pact.

Terms of the original pact, signed by American, Capital, Eastern, Pan American, Trans World and United Airlines, call for payments to be made to any member undergoing a strike called to enforce employe demands in excess of or opposed to the recommendations of Presidential Emergency Boards. Under an amendment now before the CAB, pact members, including Braniff, Continental, National and Northwest, are asking that payments be permitted in any case where an Emergency Board has not been established and the struck carrier has complied with the Railway Labor Act provisions. CAB noted that all four of the new members have reserved the right to withdraw from the pact if the Board disapproves the amendment.

Airline unions contend that the amended pact would have the effect of covering any strike of a pact member "regardless of the merits of the dispute" and term the amended agreement a "deliberate sharpening by management of conflict between labor and management."

Airlines have countered these objections by arguing that the amended payment clause is merely a means of permitting smaller carriers to participate in the agreement, since Presidential Emergency Boards are not likely to be appointed for the disputes of smaller airlines.

Seaboard Asks Doubled Cargo Contract Rates

Washington—Heavy losses sustained by Seaboard & Western Airlines on its current $4 million Military Air Transport Service contract have led the all-cargo carrier to request a doubling of its contract rate payments for the four month remainder of the MATS contract.

The airline told USAF that it has lost $2.4 million on the transatlantic contract in the past eight months and expects to lose an additional $1.2 million unless the contract is amended to provide a rate with which the carrier can break even for the balance of the agreement, which expires in September. Terming the carrier's present situation "precarious," Seaboard President Raymond A. Norden warned that its productive ability may be eliminated entirely unless quick action is taken, since the airline has been notified by the Internal Revenue Service that a tax lien will be imposed which will have the effect of closing Seaboard's operation.

In addition, Norden said owners of two of the carrier's 1049H Constellations have advised their intentions to repossess the aircraft unless substantial past-due payments are made. He also asked that any adjustment include a sum sufficient to cover the losses sustained from the tax liabilities.

Terms of the MATS contract call for Seaboard to carry 2,134 passengers a month, at an individual cost of about $64, and 349.8 tons of freight from Air Force bases such as Dover and McGuire to European points. A detailed breakdown of losses, supplied by the airline, shows that Seaboard needs a rate of $134 per passenger and $1,000.50 per ton of cargo as a break even need for the balance of the contract. Norden emphasized that the requested raise will not recoup any of the losses sustained thus far. The 1049H aircraft used on the contract are combination types which can be configured for either cargo or passengers, and one spokesman attributed much of the loss to the cost of carrying passenger seats and equipment during cargo flights for turnaround installation.

Eastern, Pan Am Pilots End Strike; Question of Punishment Still Open

By David H. Hoffman

New York—Eastern Air Lines and Pan American World Airways resumed virtually normal operations last week as pilots ended a wildcat walkout that crippled Eastern's service for 11 days and forced Pan American to cancel 12 flights while delaying many others.

In the face of mounting pressure from the courts, their own union and the Federal Aviation Agency, pilots at Eastern's Miami domicile—where the strike began on June 11—agreed to return to work late last Monday after conferring with representatives of the Air Line Pilots Assn.

Peak Day

On June 15, peak day of the strike, more than 1,300 of Eastern's 1,900 pilots had reported themselves "sick" or otherwise unable to fly. By June 21, 151 of the 600 Pan American pilots based in New York had joined the Eastern group amid indications that the strike would spread to American Airlines and Trans World Airlines.

Although this threat failed to materialize, reports that TWA pilots at the carrier's Newark and New York domiciles continued to debate a walkout were causing alarm in ALPA's Chicago headquarters.

Pilots insist that far more is at stake in the current feud with FAA than the immediate issue: displacement of the third pilot in jet cockpits by FAA inspectors. Most pilots are afraid that once the third pilot has been moved aft, regardless of the reason, the carrier is furnished with an argument that runs:

If this flight could be conducted safely with only a two-pilot crew, the third pilot is superfluous.

Thus the "third man argument," which ALPA finally won, could be revived at the bargaining tables under cover of the FAA regulation that positions the inspector up front.

Third Pilot Need

A group of 15 pilots who participated in the walkout stressed to Aviation Week in an interview that ALPA's rank and file is now "convinced" that the third pilot's presence, regardless of his contractual status, is a "must" for jet flying safety. At the same time, these pilots admitted that much of ALPA's membership doubted whether the third pilot would ever fulfill a useful role in the cockpit when his presence was made an industry issue about five years ago.

Today, jet speed, congestion along airways and traffic saturation at busy metropolitan terminals have so compressed the time available to conduct routine cockpit paperwork that airline captains are delegating more tasks to the "second officer." But because many of these chores are clerical in nature, FAA feels that the third pilot could perform them one seat farther back without in any way compromising the flight's safety.

Just under the surface of the strike is the enmity that has built up between the pilots and FAA Administrator Quesada.

ALPA membership feels that Quesada indirectly is portraying himself as the champion—and pilots as the opponents—of safety in the air.

Many airline pilots are gripped by a feeling of frustration because, they say, their flying safety accomplishments and recommendations have been ignored by both the FAA and the public.

Industry spokesmen hold that this climate of bitterness between airline pilots and the FAA actually prompted the walkout. And even the pilots admit that the walkout, which flaunted restraining orders issued by two federal courts and the policy of ALPA's Master Executive Council, was more an emotional and disorganized protest than a legitimate strike.

ALPA's Part

Organizationally, ALPA played no part in the movement, except to urge that pilots return to work after Eastern, and then later Pan American, American and TWA, had obtained injunctions against the walkout. Telephone committees, normally used to conduct ALPA business, kept pilots at Eastern's eight U. S. domiciles abreast of strike developments. Officers of the ALPA councils involved in the walkout—many of whom were named in the court restraining orders—continued to fly schedules for Eastern and Pan American.

However, through President Clarence N. Sayen, ALPA has announced that it will "spare no effort" in framing a legal challenge to the special Civil Air Regulation promulgated by the FAA to ensure inspectors the third seat in jet cockpits.

As the pilots removed themselves from company sick lists last week, Eastern and Pan American management still had reached no decision on what disciplinary action, if any, would be aimed at the strikers. Eastern's President Malcolm A. MacIntyre promised in a statement that his company would not "impose or seek penalties" against employes who walked out. But at the same time MacIntyre reserved Eastern's "rights" in relation to leaders who "intimidated or incited" others to participate in the walkout.

In New York, a Pan American official said that the question of punishment had not been "closed."

FAA, on the other hand, made it clear that any aircrew member who refused a flight because an inspector insisted upon the forward observer's seat would be summarily suspended. Ratings would be reinstated only after the crewman submitted to the prescribed flight check, the agency said.

Frequency of Checks

In reporting the frequency with which Eastern's Douglas DC-8 flights are being checked by inspectors, the FAA and the pilot group again locked in disagreement. According to the FAA, frequency of inspection hinges upon the number of inspectors available. On well-proven aircraft, it says, one inspection is accomplished for every 1,000 flights. With relatively new transports such as the DC-8, inspections now are averaging one for every 500 flights, an official FAA source reported.

But Eastern pilots based in Miami maintain that recently inspectors have been checking about 20% of scheduled departures. On June 7 alone, one pilot told Aviation Week, Eastern captains declined three DC-8 flights on which inspectors requested the third pilot's seat.

Improper Control Cited in 707 Crash

Washington—Civil Aeronautics Board reported last week that the crash of a Boeing 707-227 near Arlington, Wash. on Oct. 19 was probably caused by structural failures developed during an improper recovery from a Dutch roll.

The accident occurred during a demonstration and acceptance flight prior to delivery of the airplane to Braniff Airways. Four of the eight occupants were killed. The Board concluded that the accident was a result of the structural failure of numbers one, two and four nacelle pylons and fire at the point where No. 2 nacelle broke off.

CAB found that the nacelles failed as a result of overloads imposed on them during violent, uncontrolled gyrations experienced when improper control movement was applied in an attempt to recover from a Dutch roll. The Dutch roll was initiated as part of the demonstration flight, but the CAB said that it was applied at an angle of bank far in excess of company limitations.

Delta, National Favored for Routes to West

Washington—Delta Air Lines and National Airlines won recommendations for major route extensions to the West Coast last week in Civil Aeronautics Board Examiner Edward T. Stodola's report on the Southern Transcontinental Service Case.

The examiner's decision, which recommended transcontinental routes for both Delta and National but failed to support any significant route changes for the Big Four applicants, may represent a major test case for the newly constituted Board with respect to the five-year-old policy of strengthening small carriers through the award of major route extensions. Although Stodola stressed that his decision was based on one standard—public interest and the public convenience and necessity—there is evidence that this CAB policy may have had some influence in the proposed selection of carriers.

An examiner's decision is not final, and it can be—and often has been—overturned by the Board in its final decision. The final decision in the Southern Transcontinental Case will throw some light on the new Board's stand on the route award philosophy.

Essentially, Stodola recommended a Florida-California route for National across the southern tier of states from Miami to San Francisco/Oakland via Orlando, St. Petersburg, Houston, San Antonio, El Paso, Tucson, Phoenix, San Diego, Los Angeles/Long Beach.

In addition, the airline would have a second segment between Houston and San Francisco/Oakland via Dallas, Fort Worth, Lubbock, Albuquerque and Las Vegas. For Delta, Stodola recommended a route from Florida to the West Coast across the northern part of the southern states. The carrier would serve the San Francisco/Oakland co-terminals beyond Albuquerque on one leg and the Los Angeles/Long Beach co-terminals beyond Albuquerque on the second leg.

Here are the other recommendations made in Stodola's report:

- **American Airlines** certificate should be amended to permit service between Los Angeles and San Francisco in its transcontinental route.
- **Braniff Airways** should be granted a new route segment that would permit service between Fort Worth and the co-terminal points Miami and Fort Lauderdale via Dallas, Houston, New Orleans, Tampa and St. Petersburg.
- **Continental Air Lines'** authority to serve Houston should be renewed on a permanent basis and the Airline's certificate should be amended to provide a new route segment between Houston and Los Angeles/Long Beach via San Antonio, El Paso, San Diego.
- **Eastern Air Lines** should be given a new route segment between Atlanta and San Antonio via Birmingham, Jackson, Shreveport, Dallas and Fort Worth.
- **Interchange services** should be terminated on the southern transcontinental routes. Interchanges are now authorized for these airline combinations: Continental-American, Delta-American, National-Delta-American and Braniff-TWA.

In his conclusions, Stodola said that considerations in the selection of an air carrier for a route are a part of the ultimate problem of public convenience and necessity and "that good service to the traveling public is in the long run tied to and heavily dependent upon the well being of the industry."

He noted that a substantial part of the record in the case consisted of "outspoken support" from civic parties for one or another of the large carriers. He said that in the large majority of such civic endorsements, "Eastern has received the nod."

Stodola said "a judicial proceeding is not a popularity poll" and added that his decision in the selection of carriers for the routes "rests entirely upon the proof adduced through the formal procedures of adjudication."

Operating Restrictions

On the point of operating restrictions, the examiner said it would be "short-sighted and even dangerous" to hamper jet operations by imposing such restrictions on authorized services over the new route as "same flight," "closed door" or "mandatory stop." He added:

"The Board's policy has been to impose various non-service types of restrictions in addition to the usual long-haul limitations on turnaround operations only in those situations where the public interest clearly required them. That policy will be followed here."

Thus, he said National, as the carrier selected to serve primary transcontinental service needs, should have sufficiently broad authority to permit full development of the new service. It is for this reason that Stodola recommended that National be permitted to serve the intra-regional segment between San Diego and San Francisco on its long-haul transcontinental flight.

He admitted that the addition of another carrier on the highly competitive West Coast route would divert traffic from carriers already established on the route, but he felt this diversion would not be substantial.

In order to prevent undue duplication of routes, however, Stodola opposed giving Delta similar operating authority on its proposed route. In the grant of Continental's route from Houston to the West Coast, he proposed that the carrier should not be permitted to operate a single-plane service over the new route from San Diego and Los Angeles/Long Beach to any points other than El Paso, San Antonio and Houston.

Purpose of this restriction was to prevent Continental from providing through-plane service from Dallas, Fort Worth and Lubbock to the West because "the record is clear that there is not at present sufficient traffic to provide economic support for an operation by Continental in the Dallas market in addition to the operations of American and Delta."

Additional service, Stodola said, might harm development of the new southern transcontinental route by Delta. He said:

"This is consistent with the examiner's basic policy of avoiding destructive point-to-point competition in the area under investigation and the well-known evil consequences thereof."

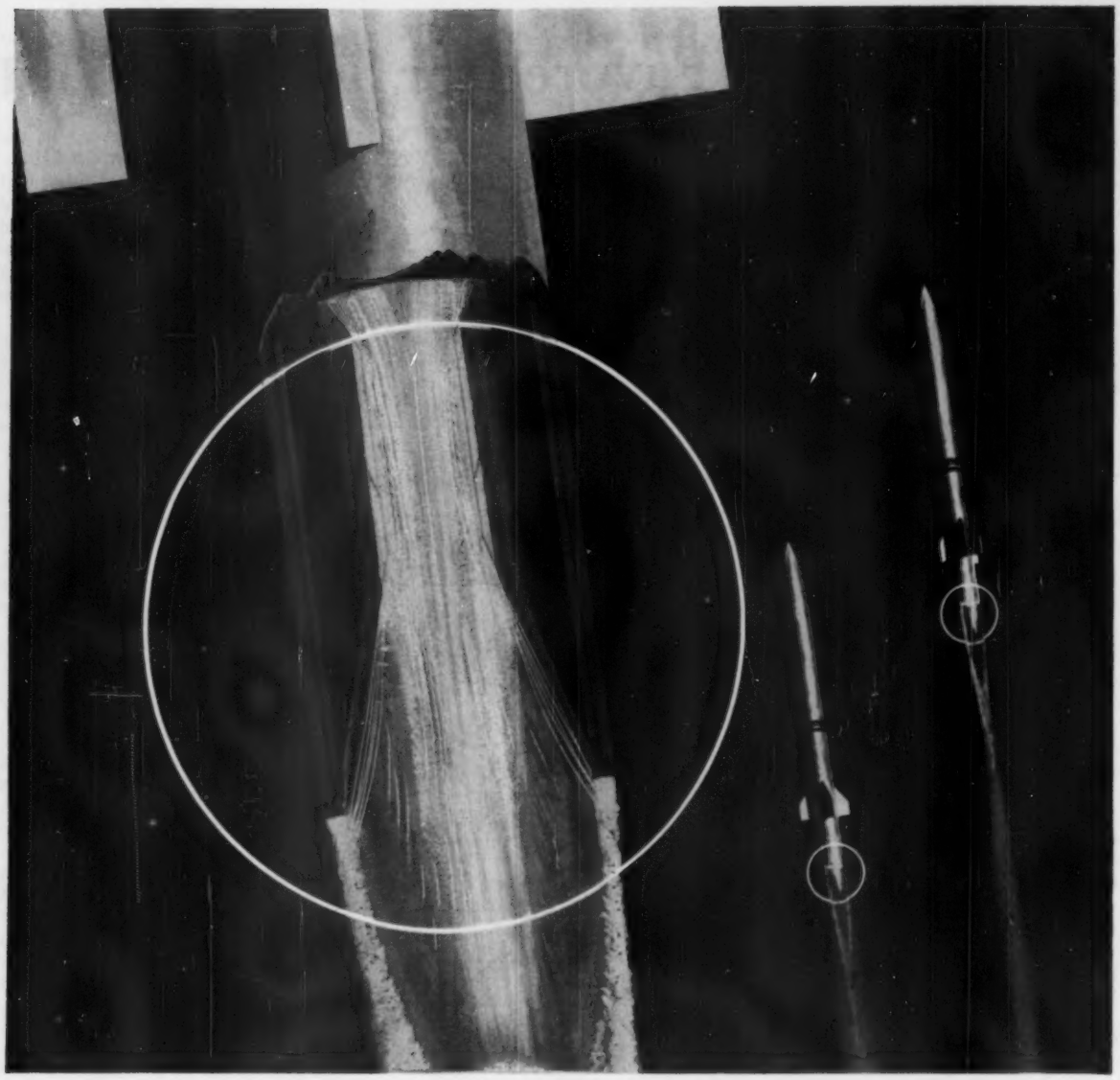
Commenting on an American Airlines request that all new authorizations should be restricted against the payment of subsidy, Stodola had this to say:

"While no air carrier applicant in this proceeding stated that subsidy support would be required and each applicant other than Capital expressed a willingness to accept American's proposed restrictions against subsidy, it is clear that such a restriction should not be imposed. . . . There are no findings which can be made here that the Board can make later which would change the mail pay need provisions of Section 406 of the Federal Aviation Act and the rights which every certificated carrier has under the Act. Nor is there anything to preclude a carrier from accepting a restriction against subsidy in this proceeding and then coming back to the Board sometime later to request relief . . ."

CAB Appoints Gough Safety Bureau Chief

Washington—Civil Aeronautics Board has appointed Melvin N. Gough Director of its Bureau of Safety, effective early next month.

Gough has served with the National Aeronautics and Space Administration as director of the Atlantic Missile Operations Office at Patrick AFB, Fla., since 1958 and previously was NASA's chief, Flight Research Division, Langley Field, Va.



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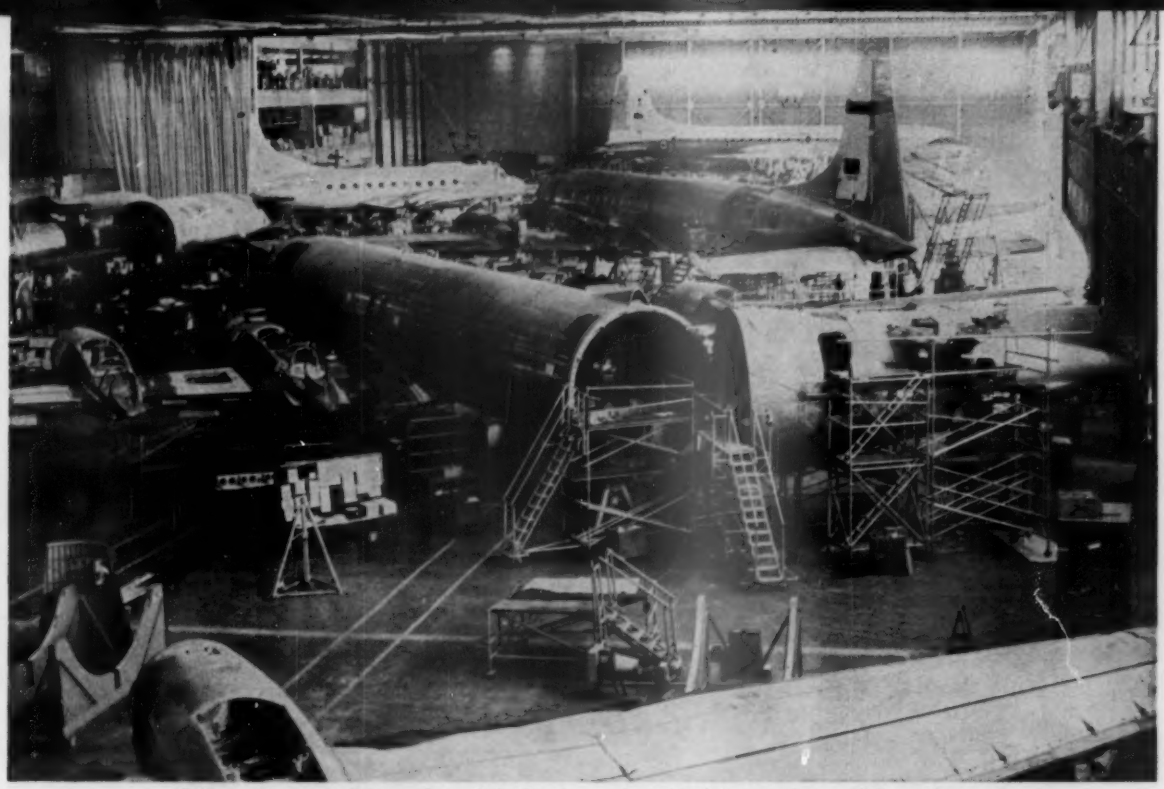


First Canadair CL-44 Swing Tail Mated to Fuselage

First actual swing tail for the Canadair CL-44 turboprop transport is mated to the forward fuselage at Montreal, Can., after locking and sealing and alignment had been checked out on a functional test rig. First production swing tail will roll out in August and deliveries to Flying Tiger Line, Seaboard & Western and Slick Airways are scheduled for January, 1961. System permits cargo loading directly into the full cross-section of main cargo compartment (AW Nov. 2, 1959, p. 52). Tail section is mounted on two hinges on right side of CL-44 fuselage, with streamlined glass fiber fairings over the hinges. Inflatable seal maintains cabin pressure; actuators to swing tail open or closed are located in the dorsal fin and consist of two interconnected articulated hydraulic jacks capable of 12,000 lb. operating force.

Airline Passenger Fares Increase; Local Airline Rate of Return Set

Washington—Airline passenger fares increased an average of 5% this week to a new rate level that the Civil Aeronautics Board figures will raise industry profits an estimated $84 million a year.

Trunk and local airlines are increasing their fares 2.5% plus $1 per one way ticket with CAB approval, a move which brings to an end the confusion stemming from the Board's approval of higher passenger fares in April (AW May 30, p. 38). Unlike the earlier announcement, the latest decision specifies the rate of increase.

CAB announced at the same time that local airline subsidy will be set on the basis of a 12.75% return on investment. This decision in the Local Service Rate of Return Case is expected to raise local airline subsidy about $4.5 million a year, using an industry investment base of $65 million and allowing for income taxes. CAB expects added revenues from the fare increase to reduce this subsidy estimate somewhat.

While the Board's passenger fare order specifies increases averaging 5% and resolves the confusion rising from the more general April announcement, CAB points out that this latest decision is not a final decision in the General Passenger Fare Case. It is intended to settle the issue of varying tariffs filed by the airlines as a result of the April announcement.

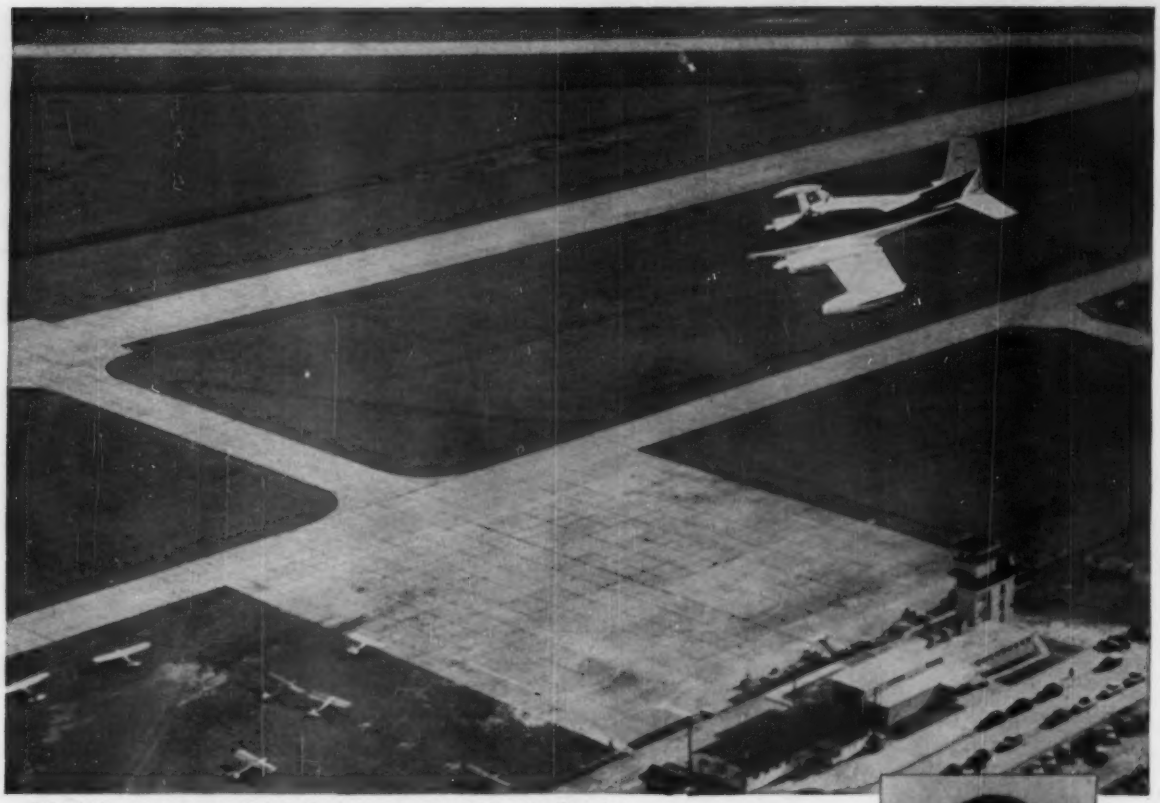
The Board's announcement noted that this latest increase, which follows increases totaling 10% approved in 1958, was authorized to give the trunklines an opportunity to reach a 10.5% rate of return, "during a reasonably extended period in the future" and to afford more financial leeway for the airlines to experiment with promotional fares to offset increased seat capacity. Decision was concerned directly with trunk fare levels, but local carriers also are permitted to increase fares under this authority.

Present jet surcharges, which CAB will allow to remain in effect, and the $1 increase per ticket will expire June 30, 1961, while the 2.5% increase was approved for an indefinite period.

CAB members are reluctant to predict any decision date for the General Passenger Fare Case, but they point out that higher tariffs already suspended, plus a study of whether existing over-all fare levels are reasonable or unjust, are still to be determined in the case. Industry observers feel that since the new fare raise is in addition to the interim fare increases granted two years ago, the Board may also delay any final decision to study the effect of the new fare raise.

CAB Member G. Joseph Minetti, who in the past has favored a rate of return based on an operating margin, did not agree entirely with the Board's rate-making standards, but CAB said he voted for the fare increase "because of the continued short run need reflected in abnormally high operating costs and low load factors."

The new rate of return for local service carriers calls for a rate of 12.75%, or no less than three cents a plane mile, for all projected future mail rates and has no bearing on past period rates for retroactive subsidy payments. In the past, CAB has allowed a 9.5% return with a two cents per plane mile floor for future rate estimates. The new floor of three cents will apply in special cases where the carrier's investment is below 25 cents per revenue plane mile, CAB said.



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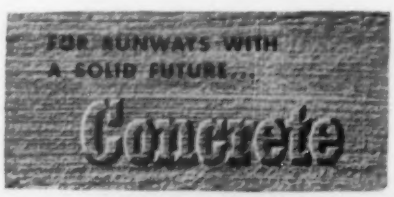


1960 Atlantic Travel May Near 2 Million

By Glenn Garrison

New York—Air passenger traffic on the North Atlantic may approach the two million mark in 1960, an AVIATION WEEK survey discloses.

On the basis of results to date and advance bookings, the carriers are estimating increases which would raise the 1959 scheduled passenger total by 30% to about 1,777,500. If these predictions hold up and transatlantic charter business zooms as expected, the over-all passenger total should reach 1,950,000. The million mark was passed for the first time in 1957.

Despite a sharp increase in capacity this summer with almost all the carriers now operating jets, there is every indication that load factors will remain high through the peak season this year. When the off-season arrives this fall, the picture may not be as bright, some carriers believe. At that time demand will be much less and the full impact of the new capacity will be felt.

Scheduled traffic during the first four months of 1960—before the big influx of jet seats—was up 23% to 339,794 passengers. Charter traffic, which totaled 172,647 passengers among the International Air Transport Assn. scheduled carriers last year, was down from 53,882 passengers to 24,450 for the four months. Military traffic is not included in the 1960 charter figures and was included in the 1959 total.

Military Contract

Although a giant military contract handled by Trans World Airlines last year accounted for about 90,000 of the charter passengers, most airlines report great charter activity this year so the over-all total should not diminish.

Here is the bullish transatlantic picture this year as seen by the individual IATA carriers now operating jets:

• **Air France carried** 99,484 passengers on the route last year, expects an increase of 42% for 1960. Capacity for June is up 46.9% to 12,668 eastbound seats, all but 357 of them in jets. First Boeing 707-320 service began in February in New York, has been extended to Los Angeles, Chicago and Anchorage (on the Paris-Tokyo route). Configuration is 90 economy, 32 first class. Air France handled 22 transatlantic charters last year, expects an increase to about 35 in 1960.

• **Alitalia's 1959 passenger** total was 39,596 and the prediction for this year is 70,000. Like most other transatlantic operators of the Douglas DC-8, Alitalia's jet service was delayed when deliveries were held up for modifications. First jet service began June 1 instead of Apr. 15. By Aug. 1, the carrier's transatlantic operation will be all-jet. Configuration is 100 economy, 24 first class. Charter passengers last year totaled 5,775, but the 1960 charter total will be down, because the jet delay kept one DC-7C out of charter work and another DC-7C was lost in a crash at Shannon. The 1960 Olympics at Rome has boosted Alitalia's bookings, as well as providing a stimulus to European travel in general.

• **Air-India International** began its first service to the U.S. in May with 707-420 equipment. Peak schedules this year will be three flights weekly. Configuration is 96 economy, 32 first class. Load factors on eastbound flights were 100% for three weekends in a row in May-June.

• **British Overseas Airways Corp.** expects to handle 230,000 transatlantic passengers this year, up from 211,358 in 1959. Peak season weekly seats will total 4,515 each way, an increase of 52%. Boeing 707-420 service was inaugurated in May. It might have been scheduled earlier, but BOAC delayed acceptance of the airplane until certain modifications were made. Configuration is 97 economy, 34 first class. The Boeings, de Havilland Comet 4s and Bristol Britannia turboprops compose BOAC's entire transatlantic fleet this summer. Charter passengers last year totaled 1,200; the total is expected to jump to 7,500 this year.

Atlantic Jet Timetable

Great majority of transatlantic airlines inaugurated their first transatlantic jet services this year. Only Pan American, Qantas and TWA had jet services the previous year. Two remaining International Air Transport Assn. carriers plan to enter the jet race next year. Here is the 1960 timetable of entries into the transatlantic jet competition:

Jan. 23	Sabena	707-320
Feb. 2	Air France	707-320
Mar. 17	Lufthansa	707-420
Apr. 16	KLM	DC-8
May 1	SAS	DC-8
May 14	Air-India	707-420
May 30	Swissair	DC-8
June 1	TCA	DC-8 (Conway)
June 1	Alitalia	DC-8 "
Dec. 15 (estimate)	Irish	720

In addition to these new entries, Pan American added DC-8s to its transatlantic jet fleet, and BOAC on May 27 inaugurated 707-420 service, supplementing its de Havilland Comet 4 jet services.

• **Irish International Airlines** carried 23,000 passengers last year and expects a total of 28,000 in 1960. This estimate assumes inaugural in December of Boeing 720 jet service. The Irish carrier now operates Super Constellations leased, with crews, from Seaboard & Western Airlines. Irish Airlines provides the stewardesses. No charter passengers were carried in 1959; 10 charter flights are estimated for 1960.

• **KLM Royal Dutch Airlines** carried 120,000 passengers on the route last year. A substantial increase is expected this year, but no estimate was made. Peak weekly capacity this year is 3,350 seats, up from 2,830 in each direction in 1959. Of the 1960 total, 2,000 are jet seats. KLM's DC-8 service, originally set for Apr. 2, began Apr. 16. Configuration is 93 economy, 24 first class. The airline is uncommunicative regarding its charter business, but normally is very active in the field.

• **Lufthansa German Airlines** expects to almost double its passenger total from 60,707 to 112,000 this year. Of the total for 1960, some 88,000 are expected to arrive and depart New York and the other 24,000 at Chicago and San Francisco. Monthly capacity at peak this year will total 7,776 seats, up from 5,796 in each direction. All service is jet this year except a weekly average of two extra sections out of New York. Boeing 707-420 service began Mar. 17 at New York, May 14 at San Francisco and May 16 at Chicago. Configuration is 120 economy, 24 first class. Lufthansa handled 15 charters last year, estimates a total of at least 30 for 1960.

• **Pan American World Airways** carried 335,593 scheduled transatlantic passengers last year. This total, added to that of BOAC, the only other jet operator during most of last year on the Atlantic, exceeds half a million, so the two carriers between them handled more than half as much traffic as all the carriers handled just two years earlier. Pan American estimates an increase of 15% this year. Peak weekly seats last year totaled about 10,400 both ways, and will increase about 15% this season. Of the 1960 capacity, 90% will be jet. PanAm operates its own 707-320s and DC-8s and some TWA 707-320s on the Atlantic. Maximum configuration of the aircraft is 93 economy and 32 first class. PanAm expects to do about the same amount of charter business it did in 1959, when charter passengers totaled 18,615.

• **Qantas Empire Airways** is offering 184 seats eastbound a week in 707-120s this summer. Last season the two weekly flights were made with 60-passenger Super Gs. Configuration of the

jets is 60 economy, 32 first class. No charters are planned.

• **Swissair expects a 30% increase** over its 1959 total of 22,966 transatlantic passengers. Peak weekly eastbound capacity last year was 900, will rise to 1,380 this year with nine DC-8 flights and four DC-7C schedules. Swissair's jets began service May 30, delayed from May 6. Configuration is 92 economy, 28 first class. No estimate of charter activity was made.

• **Sabena Belgian World Airlines** looks forward to at least a 40% increase in scheduled business over last year's 54,010 passenger total. Weekly peak capacity will increase from 1,596 to 2,016 eastbound seats. Capacity is now all-jet. Sabena put its 707-320s on the Atlantic route in January. During the peak season, they will provide 124 economy and 18 first class seats each, a total of 142. Non-peak configuration is 96 economy and 34 first class. Charter business last year totaled 3,296 passengers in both directions. Prediction for 1960 is 4,000.

• **Scandinavian Airlines System** expects a 15-20% increase over its 102,586-passenger 1959 total. Eastbound capacity will total 2,975 seats in a peak week, a 30% increase. Of the 1960 peak capacity, 56.2% or 1,673 seats will be in jet aircraft. SAS had planned its first DC-8 service Apr. 8, actually put them on the route May 1. Configuration is 92 economy, 28 first class. By fall, the transatlantic SAS operation will be all-jet. The carrier handled 76 charter flights last year and expects the total to be about 150 in 1960.

• **Trans World Airlines,** jetless on the Atlantic during most of 1959, carried 145,587 passengers during the year. The total will leap to 250,000 in 1960, TWA estimates. This year's peak weekly capacity will be 10,024 seats in both directions—88% jet—compared with 6,182 in 1959. TWA's 707-320s provide 102 economy and 28 first class seats. Charter traffic totaled 102,097 passengers last year, of which 88% resulted from the MATS contract noted above. This year, the airline expects much less charter activity.

• **Trans-Canada Air Lines** predicts a 79,935-passenger transatlantic total in 1960, up from 64,389 last year. First Rolls-Royce Conway-powered DC-8 service on the route was June 1. Configuration is 99 economy, 28 first class. Last year's peak weekly capacity, with 16 Super Constellation flights, was 1,136 seats each way. This year, with eight piston and seven jet schedules, the total will increase to 1,463. For the year, jets will provide 77.8% of TCA's first class capacity and 57.2% of its economy capacity on the North Atlantic, or 60.8% of both classes. TCA operated 33 charters on the route last year, but has none scheduled for 1960. The Canadian airline this year is operating under an agreement with BOAC calling for integration of schedules between Canada and the United Kingdom and some ticketing and ground handling cooperation.

The remaining three IATA carriers on the North Atlantic will not operate jets this year. Canadian Pacific Air Lines, now flying the run with Britannias and DC-6s, expects first delivery of its Conway-powered DC-8s early next year. El Al Israel, now operating Britannias, has ordered two 707-420s for delivery next spring, with an option for one more. Service is expected to begin on the Atlantic in July. Iberia, the Spanish airline, now using Super Constellations, is expected to order DC-8s for 1961 delivery.

Loftleidir Icelandic Airlines, sole scheduled non-IATA carrier on the North Atlantic, expects a 15% increase over last year's total of 30,000 passengers. Loftleidir bought two DC-6Bs from Pan American, and these 80-passenger aircraft this year have replaced Loftleidir's 60-passenger DC-4s. Negotiations are under way for a third DC-6B from PanAm. Frequency is eight schedules weekly in each direction. Loftleidir's round trip fare averages about $100 less than the IATA economy rate between the U. S. and Europe. Seat pitch is 38 in. instead of 34 in. The airline reports such heavy demand for space that no-show seats are largely absorbed by standbys, who report to the ticket counter all set for a trip to Europe but without confirmed space. Charter competition doesn't bother the low-fare Icelandic carrier; often, it reports, parties inquiring for charter accommodations are sold on Loftleidir service instead.

Some of the supplemental carriers who operated commercial transatlantic charters have pulled out of the market, being busy with military work or elsewhere, but others are in it even more heavily this year. For example, U. S. Overseas Airlines reports 25 charters now on its books for 1960, whereas last year the total was 10. Equipment this year is largely 98-passenger DC-6Bs, upgrading last year's preponderance of DC-4s.

Capitol Airways expects to operate 60-75 charters this year, doubling its 1959 transatlantic total. Capitol says it has had to turn away about 50 charter requests this year for lack of equipment. Equipment this year includes additional 110-seat Super G Constellations.

Flying Tiger Line, scheduled cargo carrier which was big in the commercial passenger charter market several years ago (AW June 2, 1958, p. 28), has phased out this business on the North Atlantic. In 1957, Flying Tiger's revenues from this source totaled more than $4 million; last year the figure was less than $1 million, and for 1960 it will shrink to less than $½ million, according to the airline.

The greatly increased charter activity of the IATA carriers is accompanied by some misgivings. Some airline officials say that charter bookings, in some cases, represent commitments made because of anxiety about filling the swollen scheduled capacity. The aircraft, as it turns out in some cases, could have been booked full on the higher-paying scheduled runs. Occasional jet charters are being flown this summer. At least one airline has been forced to liberalize its charter policy to meet the charter competition.

One official complained that "charter wholesalers" are springing up, trying to buy up big blocs of charter space for various groups. He cited one deal where a West Coast operator was negotiating for $1½ million in charter space. In some cases, this official said, travel agents were making up their own charter tours and selling them—a practice strictly against the rules.

Infractions of the requirement that charter groups be legitimate members of bona fide organizations have been reportedly prevalent for some time. And over-all, while charters offer flexibility to the airlines in using their equipment, they also present something of a competitive threat to the carriers' own higher-priced scheduled services.

Continuing boom in the scheduled business is attributed to these factors, among others: continued prosperity in the U. S. and in Europe; the 1960 Olympics as a stimulant to European travel; continued presence of U. S. troops overseas, which brings visiting relatives from the U. S.; the Visit USA in 1960 promotion here; the cumulative effect of promoting the economy fare; and, of course, the traffic-stimulating effect of the jets themselves, which give the two- or three-week vacationer additional time to visit his destination.

Sir Matthew Slattery To Head BOAC Board

London—Minister of Aviation Duncan Sandys has confirmed appointment of Rear Adm. Sir Matthew Slattery as chairman of British Overseas Airways Corp. (AW Apr. 4, p. 39), replacing Sir Gerard D'Erlanger.

Chairmanship, which has previously been part-time, now will be full-time and salary has been raised to $23,800 a year, with a $2,800 expense allowance, from the previous salary of $14,000 with similar expenses.

Airline Officers Salaries Filed With CAB

Washington—Following is a list of local service airline officers' and directors' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, 1959, as reported to the Civil Aeronautics Board.

North Central Airlines, Inc.—**H. N. Carr**, president, general manager and director, $40,000 salary, $800 director's fee, $4,425 expenses and 53,300 shares of common stock; **F. N. Buttomer**, vice president-traffic and sales, $15,600 salary, $2,767 expenses and 5,250 shares of common stock; **A. E. Schwandt**, vice president-industrial relations, $12,740 salary, $794 expenses and 3,675 shares of common stock; **R. H. Rendle, Sr.**, vice president-maintenance and engineering, $14,100 salary, $725 expenses and 6,825 shares of common stock; **A. D. Niemeyer**, vice president-operations, $15,660 salary, $830 expenses and no stock; **B. Sweet**, vice president and secretary-treasurer, $14,220 salary, $755 expenses and 5,250 shares of common stock.

J. P. Dow, assistant secretary (entered office 4/1/59), $6,840 salary, $693 expenses and no stock; **A. E. A. Mueller**, chairman of the board, $27,500 salary, $800 director's fee, $9,971 expenses, 550,972 shares of common stock and 48,289 shares of common stock in name of others; **W. L. Christensen**, accounting consultant and director, $2,400 salary, $600 director's fee, $210 expenses and 5,462½ shares of common stock; **G. F. DeCoursin**, sales consultant and director, $2,400 salary, $800 director's fee, $965 expenses and 9,190½ shares of common stock; **A. L. Wheeler**, vice president, general counsel and director, $27,000 salary, $600 director's fee, $7,034 expenses, 1,050 common.

K. B. Willett, director, no salary, $700 director's fee, $380 expenses and 9,074 shares of common stock; **C. R. Hood**, director, no salary, $700 director's fee, $472 expenses and 1,155 shares of common stock.

Following firms were paid for services rendered during 1959: **Klau-Van Pietersom-Dunlap Associates, Inc.**, advertising, $336,706; **Ray & Ray**, statistical information, $10,009; **Alexander Grant & Co.**, auditing, $10,635; **H. L. Rutchick**, legal, $8,331; **Immell, Herro, Buschner & DeWitt**, legal, $18,418; **Ferris & Co.**, Convair aircraft financing, $56,500.

Ozark Air Lines, Inc.—**F. W. Jones**, chairman of the board (effective 10/16/59), $7,783 salary, $900 director's fee, $1,119 expenses and 459,867 shares of common stock; **L. Hamilton**, chairman of the board and president (resigned effective 8/5/59), $19,346 salary, $450 director's fee, $1,777 expenses and no stock; **J. H. FitzGerald**, president and director (effective 10/16/59), $13,542 salary as vice president from 5/16/59 to 10/16/59 and president from 10/16/59 to 12/31/59, $6,750 salary as general manager, $225 director's fee, $2,207 expenses and 1,000 shares of common stock; **A. G. Heyne**, secretary (effective 10/16/59), $10,000 salary, $900 director's fee, $12,900 legal fee, $208 expenses and 40,000 shares of common stock.

E. H. Green, treasurer and director (effective 10/16/59), $2,083 salary, $900 director's fee, $557 expenses and 45,933 shares of common stock; **O. L. Parks**, director, no salary, $675 director's fee, no expenses or stock; **E. W. Weaver**, director (effective 10/16/59), no salary, $900 director's fee, $3 expenses and no stock; **G. O. Shaver**, flight operations captain and director, (effective 10/16/59) $15,461 salary, $900 director's fee, $759 expenses and 114,710 shares of common stock; **C. A. Bachman**, director (effective 10/16/59), no salary, $900 director's fee, $348 expenses and 14,950 shares of common stock; **J. P. Bradshaw**, director (effective 10/16/59), no salary, $300 director's fee, $135 legal retainer, $137 expenses and 45,833 shares of common stock.

Following firms were paid for services rendered during 1959: **Turney & Turney**, legal (1957-1959), $13,616; **James Batcheler**, legal services (1955-1959), $13,718.

Pacific Air Lines, Inc., (carrier did not list bonuses or indirect compensations)—**L. Hayward**, chairman of the board, no salary, $2,058 expenses and 142,988 shares of common stock; **J. H. Connelly**, president and director, $24,999.98 salary, $3,536 expenses and 146,784⅓ shares of common stock; **W. Roche**, secretary and director, no salary or expenses and 716 shares of common stock; **F. L. Hendrickson**, assistant secretary and director, no salary or expenses and 4,890 shares of common stock; **T. R. Mitchell**, executive vice president and director, $19,999.68 salary, $6,502 expenses and 1,400 shares of common stock.

R. E. Costello, vice president—traffic, $12,208.27 salary, $2,711 expenses and 500 shares of common stock; **M. A. King**, vice president—sales, $11,600.04 salary, $6,147 expenses and 20 shares of common stock; **E. R. Dahl**, treasurer, $11,000.04 salary, $821 expenses and 200 shares of common stock; **C. A. Myhre**, vice president—finance (entered office 5/12/59), $11,467.74 salary, $527 expenses and no stock.

Following directors were not paid a salary: **D. T. O'Shea**, no expenses and 1,162 shares of common stock; **W. B. Smullin**, no expenses and 100 shares of common stock; **H. S. White**, $57 expenses and 100 shares of common stock; **W. Goetz**, no expenses and 7,288 shares of common stock.

Following firms were paid for services rendered during 1959: **T. Seamon**, legal, $33,994; **Grant Advertising**, advertising, $230,932; **Washington Employers**, legal negotiator, $6,852; **Price Waterhouse & Co.**, accounting and auditing, $14,342.

Piedmont Aviation, Inc., (carrier did not list bonus or indirect compensation, but listed director's fee in lieu)—**T. H. Davis**, president, treasurer and director, $25,008 salary, $4,829 expenses, 115,621 shares of common stock and $50,000 in debt securities; **C. G. Brown, Jr.**, vice president and director, $13,512 salary, $2,892 expenses and 4,200 shares of common stock; **H. K. Saunders**, vice president and director, $16,008 salary, $2,909 expenses and 4,225 shares of common stock; **R. S. Northington**, vice president and director (salary and expenses charged to the General Aviation Division), $11,004 salary, $2,724 expenses and 6,100 shares of common stock; **M. F. Fare**, secretary, assistant treasurer and director, $10,800 salary, $1,741 expenses and 6,151 shares of common stock; **T. W. Morton**, assistant controller, $8,460 salary, $394 expenses and 200 shares of common stock; **R. N. Hanson**, assistant secretary, no salary, expenses or stock.

Following directors were not paid expenses and were paid fees in lieu of a salary: **G. E. Anderson**, $100 fee and 100 shares of common stock; **E. L. Davis**, $150 fee and 8,036 shares of common stock; **E. L. Davis, Jr.**, $100 fee and 5,622 shares of common stock; **W. F. Dowd**, $100 fee and 1,000 shares of common stock; **R. W. Gardner**, no fee and 13,000 shares of common stock; **B. Gray**, no fee and 10,000 shares of common stock; **C. E. Norfleet**, $100 fee and 2,679 shares of common stock.

Following firms were paid for services

First American Intermediate Range Boeing 720

First American Airlines Boeing 720 intermediate range jet transport takes off at Boeing's Transport Division, Renton, Wash., powered by Pratt & Whitney JT3C-7 engines. American has ordered 25 of the 720s, of which 15 are B-models, powered by P&W JT3D turbofans (AW Jan. 4, p. 37). First 10 eventually will be retrofitted to turbofans. Plane enters service this summer, carrying 98 passengers.

FAP

OKD

Allison Prop-Jet Convair certificated for commercial service by Federal Aviation Agency

The Allison Prop-Jet Convair met or exceeded all requirements by the FAA as well as guarantees by Allison during the grueling tests for certification.

This jet-age aircraft with time-proven power plants and airframe gives airline and corporate operators:

350-mph cruising speeds
(80 mph faster than piston Convairs)

3,000 fpm rate of climb at sea level
(triple that of piston Convairs)

53,200 pounds maximum take-off weight
(3 tons more than piston Convair 340's)

50,670 pounds maximum landing weight
(over 2 tons more than piston Convair 340's)

4,180 feet of runway required for maximum take-off weight
(470 feet less than required for piston Convair 340's)

up to 30% faster block speeds than piston Convairs

Lake Central Airlines has ordered 5 of these nearly six-miles-a-minute Allison Prop-Jet Convairs – with an option for 10 more – and will introduce them this year, bringing its passengers the *fastest* scheduled Local Service in America.

Six air-minded companies have ordered corporate versions and soon will speed their busy executives at jet-age speeds across the country in Allison Prop-Jet Convairs.

Want to know more about this best buy of the jet-age? Then call or write us on your letterhead. Our Sales Engineering team will prove to you the economic and timesaving features of the Allison Prop-Jet Convair.

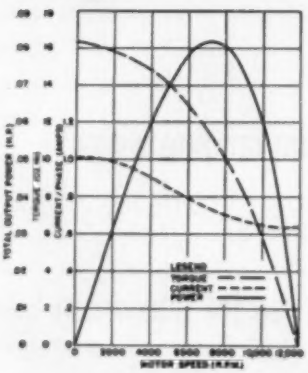
ALLISON PROP-JET POWER
ALLISON DIVISION OF GENERAL MOTORS, INDIANAPOLIS, INDIANA

GM JET POWER

Newest in Airborne's line of special motors, the HM420 Type is designed for an ambient temperature range of –65° to +600°F. Originally developed for the componentry of a Mach 3 aircraft, it is now offered to the electronics industry in general – both for its particular characteristics and as an indication of Airborne capabilities in the high-temperature motor field.

In basic design the HM420 is similar to motors built to operate at maximum temperatures up to 250°F. In materials of construction it is radically different. Ordinary copper wire windings, for example, oxidize and deteriorate above 400°F, and standard wire insulation coatings have negligible life at 600°F. Thus nickel-clad copper wire is used, insulated with glass impregnated with a specially developed high-temperature additive. Analogous problems have been solved in the case of bearing material, stator plating, soldering, etc. – to assure utmost reliability at elevated operating temperatures.

Whatever your needs in special motors – a-c or d-c – Airborne offers capabilities to meet a wide variety of design requirements, particularly where weight and bulk are critical factors. Write or phone any of our offices. New Product Bulletin PS-8A is available on request.



General Engineering Data — Airborne HM420 Type High-Temperature Motor

Rated Voltage and Frequency: 115/200 volt, 3 phase, 400 cycle induction motor
Life: 20 hr. minimum @ +600°F, plus 380 hr. @ +100°F
Altitude: Sea level to 125,000 ft.
Envelope: 2 in. diameter, 4 in. long
Heat Shock: 150°F/min.
Rated Speed: 12,000 rpm
Rated Hp. .050
Duty Cycle: 1 min. on, 10 min. off
Weight: 1.75 lb. max.

AIRBORNE®

Engineered Equipment for Aircraft and Industry

AIRBORNE ACCESSORIES CORPORATION

HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas

rendered during 1959: **Kilpatrick, Ballard & Beasley**, legal, $28,072; **Liller, Neal, Battle & Lindsey, Inc.**, advertising, $242,620; **Womble, Carlyle, Sandridge & Rice**, legal, $6,290; **Ernst & Ernst**, audit, $6,090; **Carolina Securities Corp.**, fiscal, $10,000.

Southern Airways, Inc., (carrier did not list bonuses or indirect compensations)—**F. W. Hulse**, president and director, $25,000 salary, $5,809 expenses, 36,019 shares of common stock and 2,000 shares of common stock in name of others; **G. Hall**, vice president-sales (entered office in May, 1959), $12,000 salary, $3,372 expenses and no stock; **W. S. Magill, Jr.**, vice president-operations, $16,800 salary, $958 expenses and 800 shares of common stock.

G. F. Estey, secretary and treasurer, $12,462 salary, $902 expenses and 1,521 shares of common stock; **C. H. D. Tarrer**, assistant treasurer, $10,654 salary, $462 expenses and 325 shares of common stock; **C. A. Beasley, Jr.**, assistant secretary and director, $2,400 salary, $200 expenses and 3,500 shares of common stock; **I. F. Jones**, vice president and director, no salary, $79 expenses and 3,167 shares of common stock; **W. B. White, Jr.**, assistant secretary and director, no salary, $250 expenses and 532 shares of common stock.

Following directors were not paid a salary: **I. Allen, Jr.**, $250 expenses, 3,766⅔ shares of common stock and 500 shares of common stock in name of others; **J. M. Atkins**, $120 expenses and 220 shares of common stock; **A. J. Brunini**, $197 expenses and 2,600 shares of common stock; **R. E. Orr**, $250 expenses and 1,000 shares of common stock in name of others; **F. D. Schas**, $150 expenses and no stock; **E. U. Beneke**, $150 expenses and 1,000 shares of common stock in name of others; **H. P. Johnston**, $212 expenses and 2,500 shares of common stock; **G. G. Jordan**, $200 expenses, 2,166⅔ shares of common stock and 1,666⅔ shares of common stock in name of others; **W. H. Smith**, $227 expenses and 500 shares of common stock; **E. B. Stephens**, $150 expenses and 1,495 shares of common stock; **Gen. B. H. Wooten**, $250 expenses and 6,200 shares of common stock; **A. F. Irby, Jr.**, $100 expenses and 3,300 shares of common stock.

Following firms were paid for services rendered during 1959: **Kilpatrick, Ballard & Beasley**, legal, $21,552; **Fisher, Phillips & Allen**, legal, $5,693; **Ernst & Ernst**, auditing services and consultant, $12,750.

West Coast Airlines, Inc., (carrier did not list bonuses and indirect compensation and did not list which officers are directors)—**N. Bez**, president, $18,000 salary, $2,622.95 expenses and 50,793½ shares of common stock; **E. B. Code**, vice president, $12,600 salary, $1,296.58 expenses and 494 shares of common stock; **L. J. Hawkinson**, secretary-treasurer, $14,400 salary, $1,987.47 expenses and 55 shares of common stock; **K. N. Lauria**, assistant treasurer, $8,457 salary, $499.19 expenses and no stock; **T. R. Croson**, vice president, $10,700 salary, $2,670.60 expenses and 262 shares of common stock; **H. F. Scheurer**, vice president, $15,150 salary, $2,014.71 expenses and 100 shares of common stock; **S. B. Severtson**, vice president, $14,400 salary, $1,087.61 expenses and 150 shares of stock; **S. M. Selby**, vice president, $12,000 salary, $1,783.87 expenses and no stock.

Following officers were not listed as having been paid a salary or expenses: **W. Calvert**, vice president, 9,523 shares of common stock; **J. W. Johnston**, assistant secretary, no stock.

Following directors were not paid a salary or expenses: **M. K. MacDonald**, no stock; **C. E. Gunderson**, 7,600 shares of common stock; **E. K. Bishop**, 1,961 shares of common stock; **D. Hogue**, 750 shares of common stock; **G. Dunn, Jr.**, 1,500 shares of common stock; **T. E. Robinson**, 2,000 shares of common stock; **D. G. Graham**, no stock; **F. L. Anderson**, no stock.

Following firms were paid for services rendered during 1959: **Peat, Marwick, Mitchell & Co.**, audit services, $17,000; **Leasure & Pendleton**, legal, $10,999.97; **Graham, Greene, Howe & Dunn**, legal, $27,946.02; **Henry Becken & Associates**, consultants, $13,931.91; **Washington Employers, Inc.**, labor consultants, $7,252.23; **Ernst & Ernst**, consultants, $7,815.

Moscow Now Has Second International Airport

Sheremetyevo International Airport is the secondary gateway to Moscow, after Vnukovo Airfield. Sheremetyevo handles flights of the inter-republic airlines of the Soviet Union, and Aeroflot flights from the northern regions of the Soviet Union (above). Sheremetyevo became an international airport June 1 when it began handling flights from London, Paris, Peking, New Delhi, Warsaw, Budapest, Berlin, Prague, Vienna, Sofia, Kabul, Copenhagen, Helsinki and Amsterdam. Sheremetyevo terminal is at right; the control tower is below.

AIRLINE OBSERVER

► Trunkline common stocks listed on the New York Stock Exchange reacted sharply last week to Civil Aeronautics Board announcement of a passenger fare increase. On the day following the announcement, Delta Air Lines rose 2⅞, United Air Lines climbed 2⅜. Volume of American Airlines shares traded was particularly high, and American posted a 1½ gain. Eastern Air Lines rose 1½ despite pilots' work stoppage. Activity in trunkline issues was accelerated by an advisory investment service recommending Delta and American as "stocks for action."

► **Airlines continue to hold tight control on seat capacity despite increasing number of turbine aircraft being introduced into scheduled service. As a result, load factors remain firm with only slight changes in April and May load factors compared with the same periods last year.**

► Cause of failure of number two hydraulic system of the Delta Air Lines Convair 880 turbojet transport which was forced to return to New York International Airport shortly after takeoff several weeks ago (AW June 6, p. 38), has been found to be fatigue failure of a T-fitting which leads into number four engine. Fix now is being worked out by Convair. Number two system was supposed to take over hydraulic job when the number one system of this airplane suffered a hydraulic line failure. Number one system pulls power from pumps on numbers one and two engines, number two system from engines three and four.

► **Soviet Russia is considering construction of its first monorail transportation line between southwest Moscow and Vnukovo Airport. The monorail cars would help handle an expected "fourfold" increase in Vnukovo's passenger traffic following completion of the field's first stage of reconstruction, now under way.**

► AiResearch Aviation Service Division of the Garrett Corp. plans to establish a terminal for use of supplemental carriers serving Los Angeles International Airport. Complete services will include ticket counters, passenger lobby, customer parking area and ramp space. Turnaround and maintenance crews will be provided. Terminal will be developed on a nine-acre tract which AiResearch holds under lease from the city of Los Angeles. First contract for use of the projected facility, expected to be available for service this fall, has been signed by Hawaiian Airlines for its nonscheduled transpacific charter flights.

► **Air Force has ordered five Lockheed JetStars for use in checking airways and communications facilities. The aircraft will be operated on flight paths and approaches in terminal control areas flown by larger turbojet aircraft as a means of maintaining a continuing check on the accuracy and reliability of navigational and radio air traffic aids.**

► British Air Registration Board has approved a 2,000-hr. time between major overhauls for the Rolls-Royce Mk. 524 turbojet engine powering the de Havilland Comet 4 and Sud Aviation Caravelle transports which 18 airlines are flying or have ordered.

► **Pan American World Airways began direct service from Baltimore's Friendship Airport to Paris last week with inauguration of twice-weekly round trip flights with Boeing 707-320 turbojet transports.**

► Chances are strong that procedures proposed by Sen. Jennings Randolph (D.-W. Va.) designed to accelerate Civil Aeronautics Board cases involving the substitution of local service operations for trunkline flights will draw strong support from the Senate Interstate & Foreign Commerce Committee. Sen. Randolph proposes that the Board set this standard for such cases: if a trunkline is operating but one round trip flight daily between two points, such service should automatically be suspended and replaced by a local service-carrier. Board is arguing that notice and hearing are essential to such cases and that no determinable ground rule can be established for all cases.

SHORTLINES

► **Alitalia,** the Italian airline, has signed air-sea agreements with American Export Lines, Inc., and Cunard Steamship Co., Ltd. The agreements make it possible for transatlantic travelers to fly to or from the U. S. on the carrier's Douglas DC-8 turbojets and return on the steamship carriers' flagships.

► **Civil Aeronautics Board** has ordered Northwest Airlines, Pacific Northern Airlines, Pan American World Airways, the Postmaster General and the Department of Defense to show cause why the Board should not set final military ordinary (non-air mail) mail rates for certain Pacific routes of 27.3 cents per ton-mile. The areas covered would include routes between co-terminals Seattle/Portland and Anchorage, Alaska and points in Japan, Korea, Okinawa, Taiwan, the Philippines and Hong Kong.

► **Iberia Air Lines** of Spain has established special telephone numbers connecting Albany, Buffalo, Rochester, Schenectady, Syracuse and Troy, N. Y.; Hartford and New Haven, Conn.; and Providence, R. I., with the Spanish state airline's offices in New York. Callers dial the special number for information on flights on Iberia's transatlantic routes.

► **International Civil Aviation** Organization has admitted Kuwait as its 78th member nation.

► **Los Angeles** Board of Airport Commissioners has awarded a $2,005,719.10 contract to J. E. Haddock, Ltd., for paving of aircraft apron areas at the Los Angeles International Airport's new terminal complex. The contract calls for more than 4 million sq. ft. of concrete and asphalt. Federal Aviation Agency has granted the project $1,299,706 as the federal government's share.

► **United Air Lines** will begin daily round trip Boeing 720 service between Chicago, Denver and Los Angeles July 5. On July 8, United will begin using the 720 airliner on daily service between Seattle/Tacoma, Portland, San Francisco and Los Angeles. The Boeing 720 flights will be in addition to daily Douglas DC-8 service on these two routes. United has ordered 25 of the medium-range Boeing airliners, 18 of which are scheduled for delivery before the end of 1960, with the remaining seven scheduled for delivery in 1961. The 720 airliners will have first class and air coach seating configurations ranging from 99 to 105 passengers.

OFFICE OF THE PRESIDENT • THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONN.

MEMO TO MICHAEL:

Your recent letter to the company has been brought to my attention. I am particularly interested in this paragraph,

I am in the fifth grade at Braun School and am very interested in aviation. When I grow up I want to be a deronautical Engineer if my mother will let me

**

Michael, I certainly hope you keep your desire to make a career in aviation. In my opinion it is one of the most challenging opportunities for the young men of America. The helicopter industry, and aviation in general, is helping to keep our country strong and we look forward to the help that boys like you can give when your time comes. The backbone of the aircraft industry is the engineer. We will always need good engineers with imagination and vision. You have that vision now. Please keep it. I'm sure that you can count on your mother's support when you are ready to take your place among the other young men who are playing a vital role in a vital industry.

Sincerely,

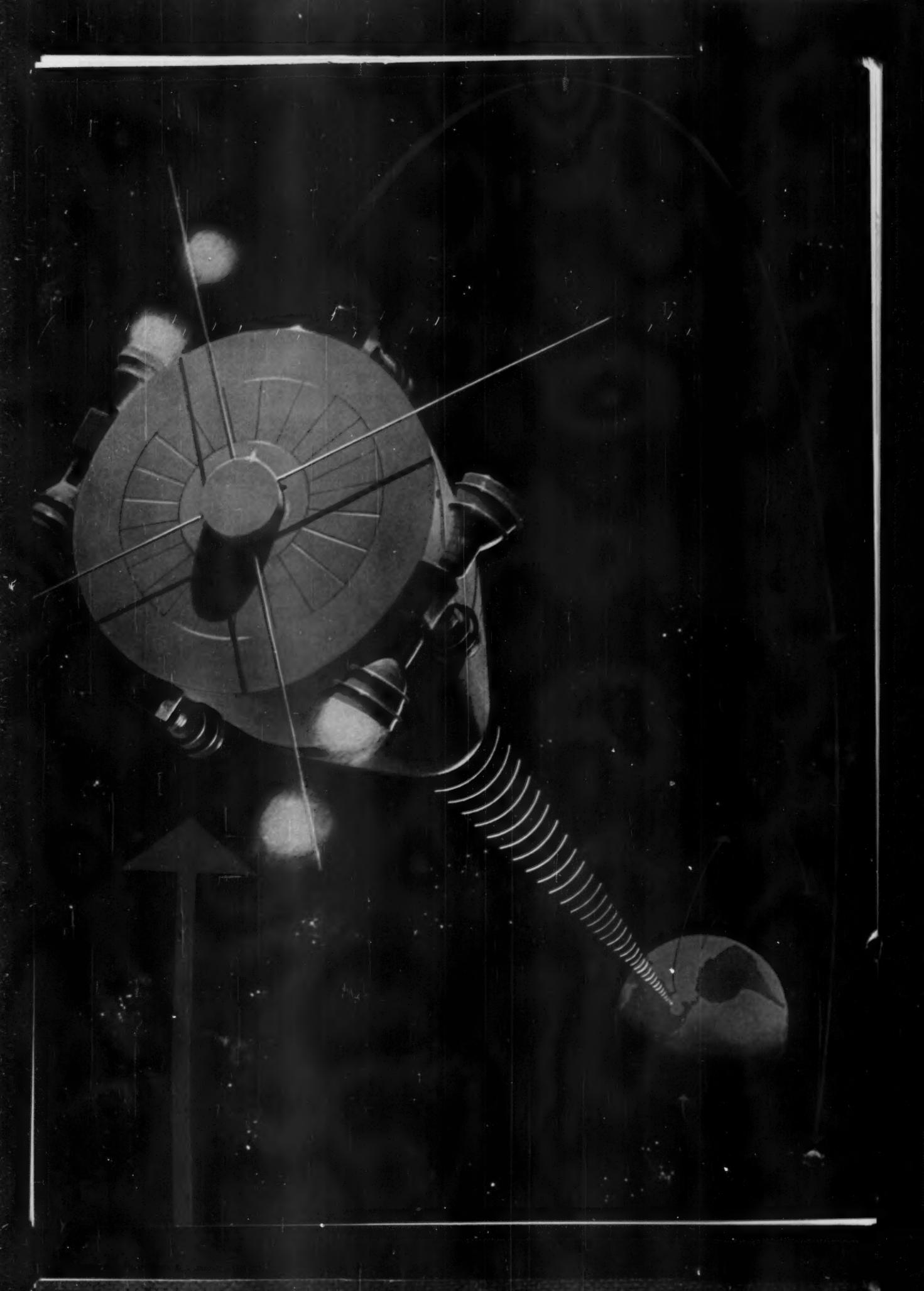
Charles H Kaman

. . . IN NATIONAL DEFENSE

KAMAN

IS PART OF THE PLAN

**Facsimile of a letter to the company



MARQUARDT PAT-C* SYSTEM MAKES POSSIBLE PRECISION SPACE CONTROL

New control gives 3500 to 1 modulation and .001 pound-seconds impulse

Orbit correction, station keeping and attitude control of a 24-hour surveillance satellite which must orbit in a fixed position 24,000 miles above a predetermined point on earth, is but one unique application of PAT-C—position, attitude, trajectory control system—a development of The Marquardt Corporation's Controls and Accessories Division.

The PAT System is a highly responsive jet reaction control which controls the flight path, the position and attitude of a space vehicle as a result of intelligence inputs from the vehicle guidance system or ground control. The system is capable of providing the necessary corrective action based on the simple position and velocity error signals or will respond to the demand of complex guidance computers in the system. The thrust level can be adjusted over a range of 3500 to one (or more in some cases) with the same set of rocket nozzles; proportional control of thrust from 0 to full thrust is possible. Impulse imparted to the vehicle can be controlled accurately over a wide range down to a few milli-seconds in duration—with a one lb. thrust nozzle as low as 0.001 pound-seconds. In the attitude control mode, the PAT system can maintain pointing accuracies not possible with other systems due to its low propellant consumption in limit cycle operation.

In a typical case, an accuracy of 0.1 seconds of arc can be held for 1000 hours with 40 lbs. of propellant.

Marquardt's fifteen years of research, development and production has resulted in state-of-art advancements in a wide range of electronic, electro-mechanical, pneumatic and hydraulic controls and accessories. For example, a pneumatic servo actuator is now available for 1600°F service—and severe nuclear radiation environments.

For additional information concerning the PAT-C System or other C & A capabilities, contact Dick Oblinger, Chief Applications Engineer-Controls and Accessories, The Marquardt Corporation.

Engineers and Scientists experienced in these or related fields will find it rewarding to discuss their career futures with Marquardt. Founded in 1944, Marquardt now has a staff of 5,000—two out of three are professional people. The company's growth is a parallel to the atmosphere of challenge and rewarding accomplishment that has existed since the firm's beginning.

Shown in photograph below—Marquardt engineers discuss a full scale mock-up of a complete self-contained PAT-C unit designed for application to space vehicles.

CONTROLS & ACCESSORIES DIVISION

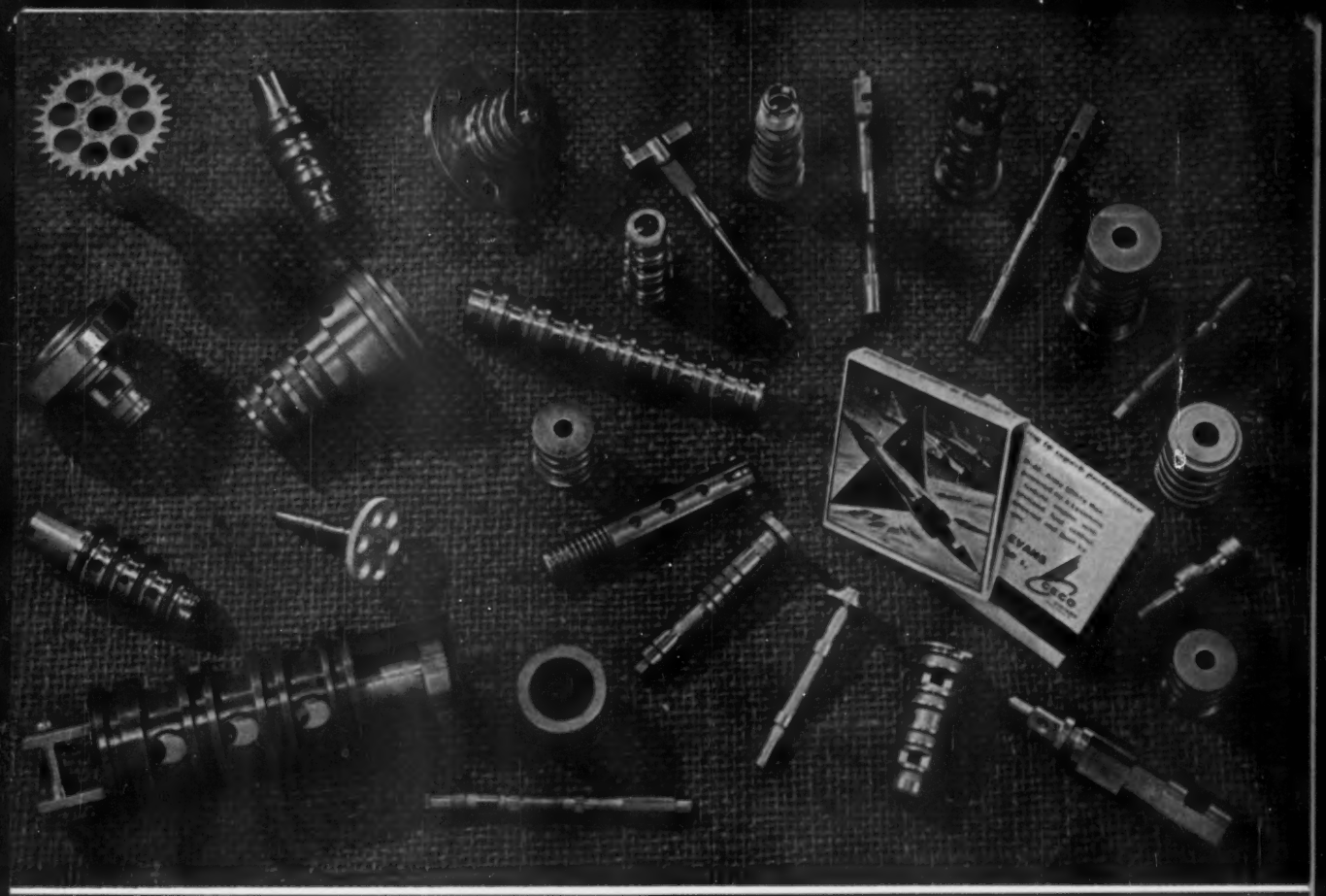
THE Marquardt CORPORATION

16555 SATICOY STREET, VAN NUYS, CALIFORNIA

ASTRO ◆ COOPER DEVELOPMENT DIVISION
◆ OGDEN DIVISION ◆ POMONA DIVISION
◆ POWER SYSTEMS GROUP

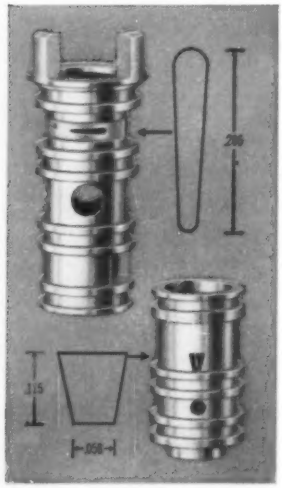
CORPORATE OFFICES: VAN NUYS, CALIFORNIA

*POSITION—ATTITUDE—TRAJECTORY CONTROL SYSTEM



Looking for a subcontractor with real servo "savvy"?

. . . THEN TAKE A GOOD CLOSE LOOK AT THE SERVO COMPONENTS DISPLAYED HERE



As a subcontractor, CECO is equipped to handle specifications demanding production tolerances to 5 millionths of an inch and finishes to .5 RMS. Most of the servomechanism system components shown above were manufactured to just such specifications.

High-precision square holes? Other unusual porting requirements? Assignments like these are considered routine in Chandler Evans subcontract operations.

Among the "tools" of CECO's servo trade are Cavitrons, ultra-sonic cleaning devices and temperature-controlled, contamination-free assembly areas.

Components, assemblies and complete subsystems can be fabricated with equal facility.

CECO
SYSTEMS
CONTROLS

For more detailed information on CECO facilities and subcontract capabilities, write Department M or call R. M. Campbell, ADams 6-0651.

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G. E. Schmitt 7046 Hollywood Blvd. Hollywood 28, Calif. HOllywood 2-1239	Norman Sarchin Boyd Building Mercer Island, Wash. ADams 2-5950	K. L. Moan 305 Spitzer Building Toledo 4, Ohio CHerry 8-5791

Extra Power Increases Saturn Reliability

By J. S. Butz

Washington—National Aeronautics and Space Administration's Saturn booster engine system will have an estimated 97% chance of completing its mission because of the spare engine power designed into its eight-engine cluster.

With the "engine-out" design approach used on Saturn, the booster has, in effect, a spare engine. Booster mission requirements are based on the thrust available from seven engines, so if any one of the eight Rocketdyne H-1 engines fails in flight, the booster can still complete its mission. Using simple probability theory and current test data for the reliability of a single H-1 engine, the Saturn booster has a 97% probability of completing its mission during the first half of its flight. This probability increases to 99.2% during the second half.

Each H-1 engine now has a demonstrated reliability of 96.5% after a development program of 830 firings and more than 40,000 sec. of running time. Mission reliability of the cluster exceeds the reliability of a single engine because of the surplus power provided in the engine-out design.

Saturn booster can have one engine shut down immediately after launch and another cut off half way through its normal two minute flight and still carry out its mission, according to engineers at Development Operations Division of Army Ballistic Missile Agency. This Army group designed the booster and will become the nucleus for NASA's Marshall Space Flight Center on July 1.

Engine-out operational capability was considered necessary for the Saturn booster because there is only a 75% chance that all eight engines would function properly during any given flight. Surplus power was supplied to fill the gap left by a dead engine. Two major design features are required to make this concept work:

- **Sensing systems,** which will detect trouble and automatically shut down malfunctioning engines before they cause an explosion or other catastrophic failure.
- **Completely independent engine** units which are fed from common propellant tankage so that if any engine is shut down during flight, the propellant load will be completely consumed and no weight penalty of unused propellants will be imposed on the vehicle.

COMPLETED H-1 engine shows accessory package mounted beside the combustion chamber. Further simplification planned for the engine will eliminate much of this package.

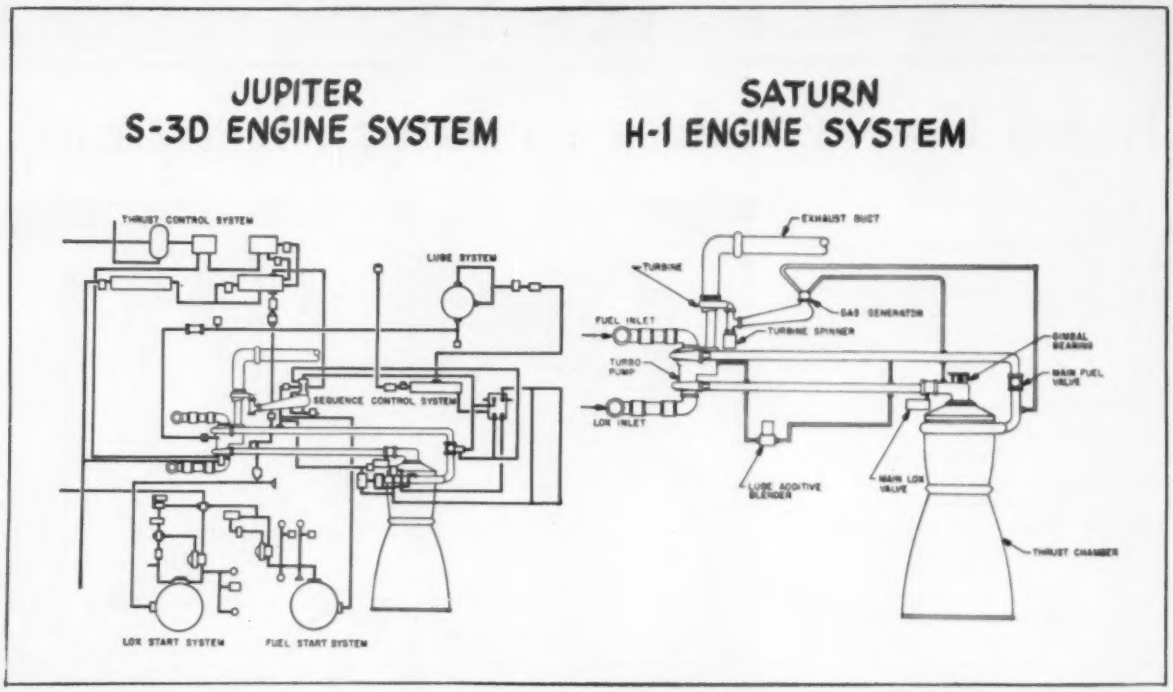
Both of these features are being used on the Saturn booster. Although there are nine propellant tanks on the vehicle, they are interconnected to prevent any propellant residue if an engine should be stopped. Final selection of systems to sense incipient trouble in the H-1 engines has not been made but a study of this problem is nearing completion. Some of the sensing systems under consideration are: chamber pressure gages, combustion vibration monitors which measure amplitude and rate of combustion chamber vibrations in three planes, turbine overspeed gages, gas generator temperature indicators, and instruments to measure differential temperature in the liquid oxygen between the tank and the combustion chamber inlet.

Thorough analysis of Saturn booster reliability which is in progress at NASA will take into account not only the reliability of the engines but also the malfunction sensing units, the relay systems used to transmit their warning signals to the engine stop mechanisms, the stop mechanisms themselves and all of the other auxiliary systems on the engines. Exhaustive analysis of this type normally would be expected to give a lower reliability figure for an engine cluster than the figure reached with simple probability theory using a round number to represent the reliability of a single engine.

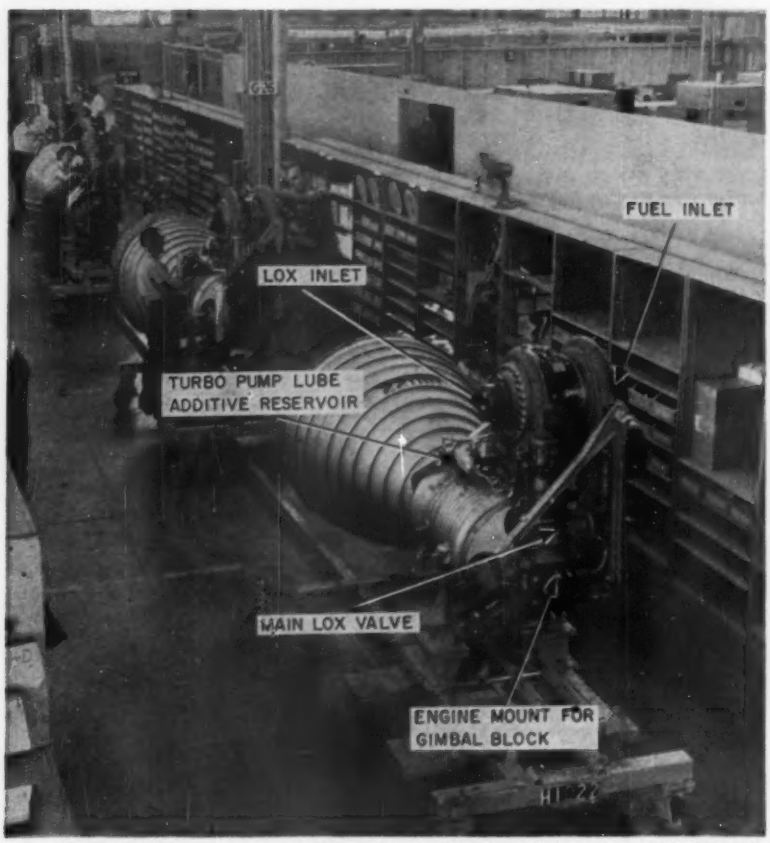
Reliability Figure

There is reason to believe, however, that this may not prove true for the H-1 cluster of the Saturn. The Rocketdyne single engine reliability figure based on 830 development firings is regarded by the company as conservative. The 30 engine firings listed as failures in this group include instrumentation as well as engine malfunctions, and the developmental engines have more auxiliary systems of this type than the operational engines will have.

Rocketdyne experience has shown that only 4% of the static firing failures would have been catastrophic in flight. The rest are termed "safe" failures and would not cause the mission to be aborted if "engine-out" design were



MAJOR IMPROVEMENT achieved in the Rocketdyne H-1 engines for the Saturn booster is in the starting mechanism. Full thrust on H-1 engine builds up automatically after one start signal, while older engine (left) requires elaborate switching operations.



MORE THAN 30 H-1 engines for the Saturn booster have been delivered to Huntsville, Ala. Production line for the engines in Canoga Park, Calif. is shown above.

used. On the basis of this experience, there is then less than a 1% chance that a catastrophic failure will occur during any Saturn booster firing.

Reliability will be higher in the second half of a Saturn booster flight because it will be possible to shut down two engines during that period and still complete the vehicle's mission. Simple probability shows that there is a 2.2% chance that two of the engines will have to be stopped during any given flight, which raises the over-all mission reliability of the booster to 99.2% after it has run approximately 60 sec.

The only restriction on shutting down two engines is that three of the four gimbaling control engines must be operating during the whole flight. Pitch and yaw control can be maintained as long as one gimbaling engine in each axis is firing, but roll control requires two engines in at least one axis. If one engine on a control axis is dead, a switching arrangement is required in the autopilot to phase this control axis completely out when roll signals are sent from the guidance system. In this case, roll control depends completely on the remaining control axis with two engines operating.

Major penalty paid by using the engine-out concept is a reduction in launch gross weight and payload to make certain that the vehicle thrust-to-weight ratio does not drop below about 1.3, even if one of the engines stops at the moment of launch. If the thrust-

to-weight ratio, which is equal to the acceleration rate in gs, drops below 1.3 the vehicle leaves the pad so slowly that the performance of current guidance and control systems is marginal.

In effect, the upper stages of Saturn vehicles will be designed as though there are seven H-1 engines in the booster and its maximum thrust is about 1.32 million lb., instead of the 1.5 million lb. scheduled to be available with eight engines. This provides essentially a spare engine which will give the vehicle a high acceleration and good performance in the early flight stages. If the spare engine has to be shut down, the primary disadvantage will be a longer burning time so that the remaining engines can consume the whole propellant load.

As burning time increases, more energy is consumed overcoming gravity. This results in lower burnout velocity and reduces the distance the vehicle can travel along any given trajectory. This has been accounted for in the over-all design of the Saturn vehicles (AW May 9, p. 52), since the booster velocity and position along a trajectory at burnout can vary within relatively wide limits and the upper stages will be used to achieve precision in trajectory position and velocity.

Early Saturn vehicle, which will have two or three stages instead of the five now planned for the final vehicles, will have large performance margins during the booster flight. This will raise their over-all reliability.

Value of the engine-out or spare engine design will diminish as engine development moves along and the reliability of each engine in the cluster approaches 100%. Rocketdyne studies show that when the single engine reliability passes 98% the use of one spare engine will provide a higher reliability than the use of two spares. Company engineers believe that as liquid propellant engines continue to be simplified and the number of their components are reduced, individual engines will approach 100% reliability. As this happens, there will be no need for any spare engines, and the increment of booster burnout velocity formerly held in reserve can be used to increase the over-all performance of the vehicle.

Current version of the H-1 engine is a development of the Rocketdyne engines used in the Navaho booster and the Redstone, Jupiter, Thor and Atlas missiles. The H-1 has less than a tenth the number of major components in any of these engines, however. This reduction in the number of components, plus the fact that components used on the H-1 have been under continuous development for more than 10 years, has resulted in a very short lead time for the engine. Rocketdyne was ordered to launch H-1 development in September, 1958, and the first complete prototype was tested the following December. First delivery to ABMA was made in April, 1959, and the ninth was made in November, 1959. First flight engine was delivered last January.

Primary simplification achieved with the H-1 engine was the elimination of the elaborate system of sensors, relays and valves formerly needed to start a liquid propellant rocket and bring it to full thrust. This ladder start sequence can now be accomplished safely without the close regulation provided by sensors and pneumatic valves. Details of the new start method are considered proprietary by Rocketdyne.

Further simplification of the H-1 engine is being investigated. The main idea behind the present work is to eliminate the gas generator which drives the turbopump for the propellants. This would make the turbopump the only major moving component on the engine. If this is done,

Saturn Reliability Estimates

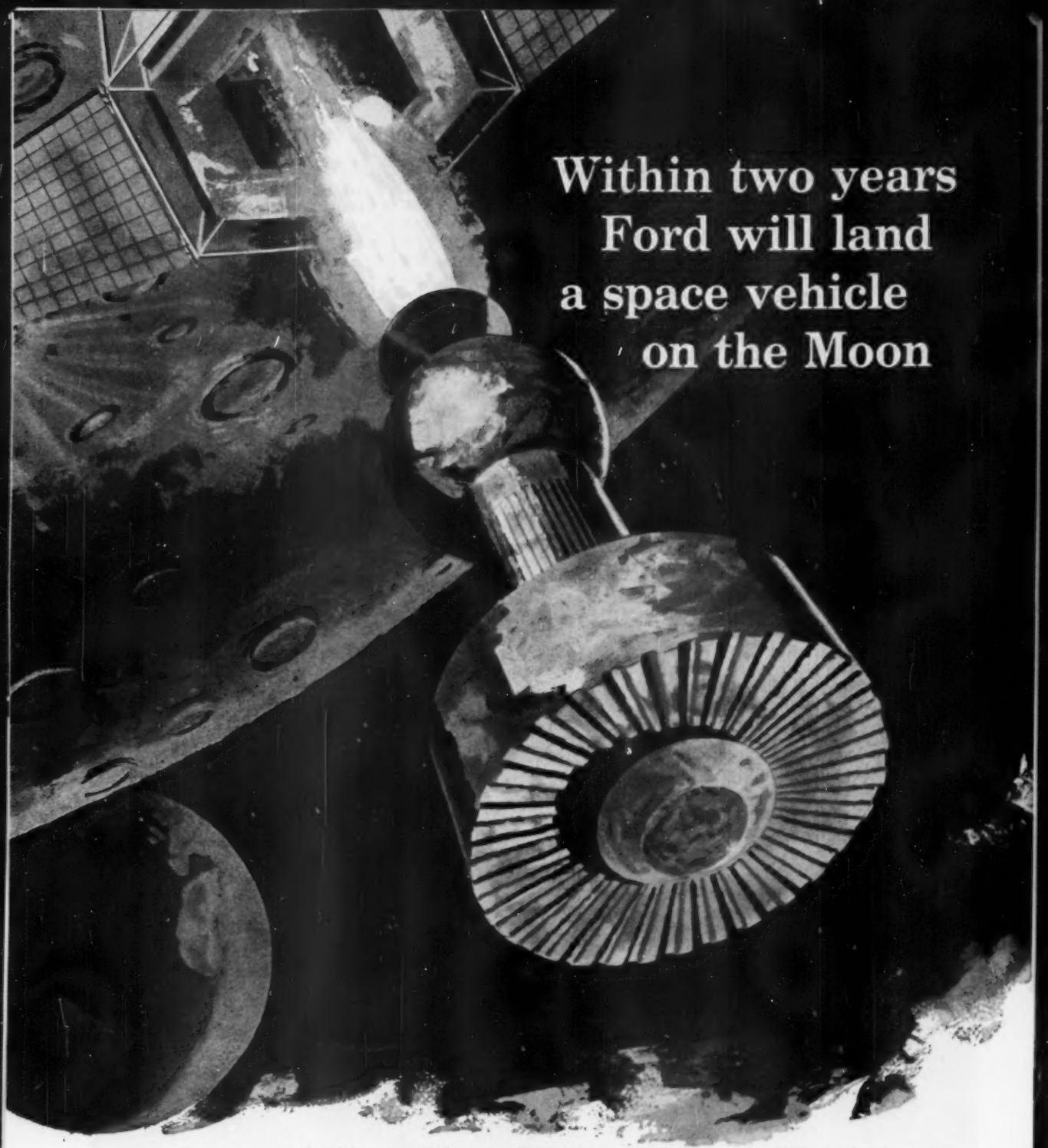
Saturn engine system reliability estimate is based on simple probability theory, using the H-1 reliability performance of 96.5% reported by Rocketdyne after 803 developmental firings. Mission completion probability for the eight-engine cluster is raised from 75% to 97% through the spare power provided with the engine-out design. This total engine system reliability estimate for the first minute of flight can be obtained by adding these two factors:

- **Probability that all engines will operate properly: 75%.**
- **Probability that one engine will malfunction: 22%.**

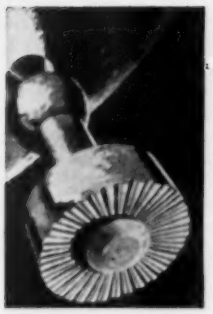
On most Saturn missions now planned, total powerplant reliability will increase 2.2% after the first minute of flight because loss of a second engine can then be tolerated. Probability that two engines, only one of them a gimbaled control engine, will malfunction is 2.2%.

X-15 Explodes During Ground Test

Explosion of X-15 rocket aircraft June 8 at Edwards AFB, Calif., occurred during ground test of Reaction Motors XLR-99 powerplant. Pilot Scott Crossfield was unhurt but the plane was damaged extensively. Preliminary investigation indicated that the blast came from the fuel tanks. North American Aviation spokesman said that the explosion may delay the X-15 program "two or three months."



A 300-pound Lunar Capsule containing scientific instruments will soon make a "rough" landing on the Moon. It will be carried by a larger spacecraft to a location about 25 miles from the Moon's surface, then released. A retro-rocket will cushion its impact. The Lunar Capsule will transmit vital scientific data back to Earth for a month or more. This unique space vehicle will be the product of Ford Motor Company's Aeronutronic Division.



THIS LUNAR CAPSULE, now under development for NASA's Jet Propulsion Laboratory, is one of many space-oriented programs now under way at Aeronutronic Division of Ford Motor Company.

These programs—and many others related to advanced weapon systems and computer systems—are being carried out at Aeronutronic's multi-million dollar Engineering and Research Center, in Newport Beach, California. They emphasize Ford's rapidly growing role in meeting the needs of science and defense in the Space Age.

A booklet describing Aeronutronic's accomplishments and capabilities is available to you on request.

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the hot gas required to drive the turbopump would be bled out of the combustion chamber. Power to start the turbopump so that it could be operated in bootstrap fashion by the engine would come from a solid propellant charge. A solid propellant charge is now being used on the H-1 engine for starting the turbopump, and it has proven highly reliable.

The simplification and reliability improvement of liquid propellant rocket engines which has taken place in the last few years has made the use of very large space vehicles more attractive. This engine improvement has also brought a better understanding of the relative merits of using clustered or single chambered rockets for powering these very large vehicles.

The Rocketdyne position on this choice of powerplant types has been outlined by S. F. Iacobellis, supervisor of the systems evaluation unit at the Canoga Park facility. Comparing single chamber engines and engine clusters of equal thrust, the company believes these conclusions apply to engines of any thrust level:

- **Single engine** has a higher ultimate reliability than the cluster. However, the use of a spare engine in the cluster can increase the reliability of the multi-chambered system to a value that is competitive with a fully developed single engine.
- **Cluster of proven** or partially developed smaller engines can be developed to an acceptable level of reliability in less time than an equivalent new single engine. For example, an eight engine cluster can be brought to 90% reliability one year sooner than a single engine if both projects have the same starting date. If the cluster is provided with a spare, it will reach a propulsion system reliability of approximately 95% two years before the single chamber engine.
- **Larger payload** can be carried by a vehicle using a single chambered booster. Considering its normally later conception date, the single engine can be expected to incorporate advancements in the state-of-the-art. Because of these advanced engine characteristics and lighter installation weight, a 10% booster payload advantage is predicted for a three stage liquid oxygen/RP-1 vehicle using a single chambered booster over an eight engine cluster with the same total thrust.
- **Development cost** of the cluster system is much lower than that of a single engine. This is due primarily to the fact that the major part of the development testing is accomplished at the smaller engine's thrust level. On the other hand, the single engine will probably have an advantage in production cost and over-all operational maintenance cost.

Scientists Study Space Pilot Automation

By Erwin J. Bulban

Brooks AFB, Tex.—Industry must develop complex mechanisms that can be implanted in astronaut's bodies to help them to automatically adapt to radically new environments if prolonged manned space flights are to be feasible, observers attending a recent aeromedical research symposium at USAF's Aerospace Medical Center here were told.

As one of the speakers put it: "If a fish wished to live on land it could not readily do so. If, however, a particularly intelligent, unsatisfied fish could be found who had studied a great deal of biochemistry and physiology, and was a master engineer and cybernetician and had excellent laboratories, this fish would be able to design an instrument that would allow him to go on land and breathe air quite readily. . . ."

Possible approaches are almost limitless, particularly during this period when many of the solutions are theoretical, but they do indicate that medical technicians and industry are barely on the threshold of knowledge and abilities that will be required to meet the challenges of manned space operations.

Opening of new fields, new markets, even completely new industries unknown today will result from the research necessary to accomplish these goals, observers indicated.

Exotic Approaches

Suggestive of what the uninitiated would consider exotic approaches in which medical disciplines could play in space flight was consideration of altering bodily functions to suit different environments. Once achieved by the long process of evolution, this can be done without alteration of heredity by suitable biochemical, physiological and electronic modification of man's existing mode of operation, according to Dr. Nathan S. Kline.

One method, Dr. Kline said, would be to provide a mechanism that could be implanted in the astronaut's body to provide injection of biochemical active substances at a biological rate to provide whatever balances man needs to overcome conditions encountered in the space environment.

The device would be self-regulating and function without the benefit of consciousness on the part of the subject—tied to sensors that would signal the rate and type of injections to be pursued.

This continuous man-machine controlled loop, operating as an adjunct to the body's own autonomous controls, for example would make possible changing these natural controls to the desired performance characteristics under various environmental conditions. For example, systolic blood pressure may be sensed, compared with a reference value dependent on space conditions encountered and regulated by comparing the difference between sensed pressure and reference value and then the mechanism would control the administration of a suitable drug.

Possible Applications

Among other possible applications of such a system:

• **Assuming radiation** is unavoidable and that drugs for protection against radiation damage are developed—a program now under way, Dr. Kline noted—sensors could respond to background count to trigger the self-regulating mechanism and administer the necessary drugs only during periods when they are indicated as necessary rather than continuously. The entire system would be self-regulating and would require no attention on the astronaut's part, leaving him entirely free to carry out other functions that could not be automatically regulated in this manner.

• **Reduction of body temperature,** utilizing enzymes and drugs acting on the brain center controlling temperature rather than by means of external refrigeration, might be utilized to reduce food and oxygen intake requirements. Hormone action could lower metabolism in the body, but maintain it in the brain so that mental activity could be left impaired, Dr. Kline suggested. Alternatively, the entire body might be cooled homeostatically, but the brain heated electronically, he added.

For flights of long duration—months or years—the crew and passengers might be maintained in a state of sleep, aroused by a special system in event flight conditions were in danger of passing outside the safety threshold, or detection apparatus could trigger wakefulness in event phenomena worth seeing occurred.

• **Oxygen requirements,** which would be difficult or impossible to provide for lengthy flights and even a closed ecological system—being studied by many laboratories—is an awkward solution; ideally an apparatus designed as an artificial lung might provide the answer. Blood could be shunted through the pulmonary artery through a microsystem capable of reducing the carbon dioxide, adding appropriate quantities of oxygen and then returned to the pulmonary vein. Or a fuel cell process might convert the carbon dioxide to carbon and oxygen, with the latter remaining in the blood stream, Dr. Kline theorized. Energy for such a system might be supplied externally from solar energy or from atomic processes within the system.

These processes would not only make breathing unnecessary, but impossible; the mouth would only be opened for food intake and speech for limited periods of time. Alternatively, feeding could be intravenous.

• **Fluid intake** and output balance is a major problem even with lowering of temperatures, Dr. Kline noted. An adaptive system to overcome this should be attempted, he believes. Basically, it might reshunt the urine after processing directly back into the bloodstream. Problem in utilizing urine as a fluid source is the occurrence of urea amounting to 25 or 30 grams daily. If the urine could be fed directly through a shunt containing urease, urea would be converted into carbon dioxide and ammonia. The former could either be handled by the system mentioned above, or serve as a substrate for conversion to oxygen by algae. The amount of carbon dioxide produced this way would serve as a good check on the adequacy of the kidney function, since the quantity of urea produced is stable.

Ammonia could be handled by using nitrifying bacteria with conversion to nitrates or nitric acid; the remaining filtrate could be treated with ion exchange resins and predetermined levels

Space Pilot's Nervous System

Brooks AFB, Tex.—The human nervous system, specifically the area in the brain, is the "key" to man's role in space exploration, Dr. Clark T. Randt, director of National Aeronautics and Space Administration's new Office of Life Sciences, told several hundred military and civilian aerospace medicine observers here recently at USAF Aerospace Medical Center.

"The elaborate systems required for space flight," he noted, "are all directed toward support of this critical 2% of the total body weight."

He described the astronauts' problems in a space capsule as being focused on altered sensory input resulting from weightlessness, isolation and confinement, in a hazardous situation with a variety of essential tasks to perform. The environment effects on man's elaborate sensory systems as they in turn modify neural activity underlying perception, memory, orientation, thought, emotion, and motor output, assume priority for consideration, Dr. Randt noted.

of blood sodium, potassium, chlorides and phosphates released to maintain appropriate equilibrium in the body with respect to various functions and compositions of fluids and tissues.

Alternate systems are possible, but the one mentioned by Dr. Kline is considered portable to provide long periods of travel away from the space base.

The seven grams of feces produced daily by a fasting man (or 10-12 grams if intravenous feeding was used) would be measurably less if lowered metabolism could be maintained. A miniaturized septic tank could be used to produce carbon dioxide which would be handled in manner described earlier; residual fluid could be again passed through columns and the filtrate containing the trace metals reinjected in the vascular system.

Absence of breathing would conserve the substantial amount of fluid normally lost in this process, so that replacement would be complete except for the small amount lost through surface evaporation which could be minimized by reducing body temperature and insulation by means of clothing or plastic coatings.

• **To combat external** temperature variations in space, and enable man to walk about unencumbered in an environment where lack of atmosphere produces temperature extremes in sunlight and shadow, control of reflectance and absorption, similar to that used on the space vehicle, might be attempted on the astronaut. Ideally, the hands and face should be protected directly—without need for clothing—so that they need not be encased. A chemically regulated system might be devised to produce necessary changes in skin pigmentation. Responsive to incident light, the process would automatically adjust pigmentation in such a way as to maintain desired body temperature.

• **Improvement of natural mobility** on the surfaces of other planets might also be improved, Dr. Kline suggests, by use of the closed loop system for varying body temperature dependent on gravitational forces. For smaller gravitation fields than those found on earth, a low body temperature would be desirable, he notes, and for larger gravitational fields a higher than earth-normal temperature. Drugs could be useful in establishing these desired conditions. A servomechanism, working in conjunction with body homeostatic controls, fields a higher than earth-normal temperature as desired by the prevailing gravitational field.

• **To combat psychotic episodes,** it may be that no servomechanism could be designed to handle all the conditions that might occur; therefore the mechanism that could trigger the release of necessary drugs might have to be controlled from earth or by a crew member.

Hercules Test Shows Anti-Missile Capability

Washington—Nike Hercules air defense missile, using an improved radar system, registered the first known kill of a guided ballistic missile in flight by downing a Corporal at White Sands Missile Range.

Army believes this engineering feasibility test showed potential of Hercules as a defense against tactical-range ballistic missiles. This would be an important capability in Europe, where Hercules installations are operational. There also were indications that the system with its new radars will be considered as a possible coastal defense against submarine-launched ballistic missiles.

Improved Hercules system also has a defense capability against air-to-ground missiles and increased capability to handle electronic jamming, according to Bell Telephone Laboratories, the designer of Nike systems. Systems modifications were supplied by Western Electric Co. and General Electric Co.

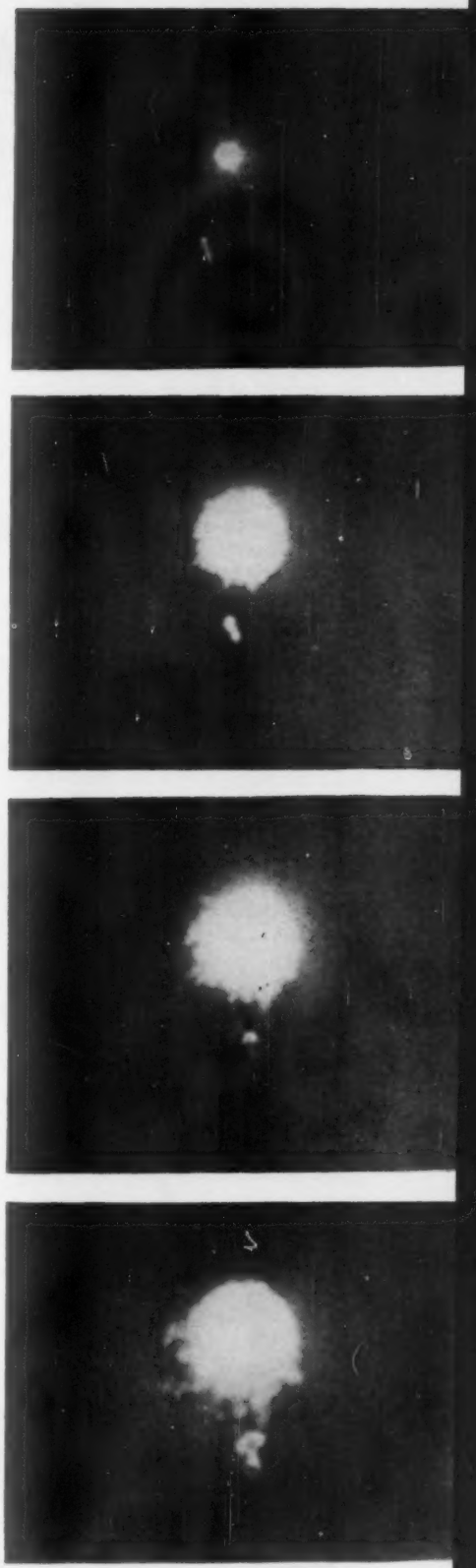
Radars used for the first time with the Hercules system were General Electric Hipar acquisition equipment, plus new Western Electric tracking and guidance equipment. Army estimates that integration of radar improvements triples Hercules' capabilities. Missile has a range of 75 mi. and an altitude in excess of 150,000 ft., the Army said. New radars are thought to advance system reaction so that the firing problem can be computed in a much shorter time span than with the present system.

Army said it will explore the new radar system to "its full capabilities," including possible tests against Sergeant. Tests will continue over the year. Present Hercules installations could be re-equipped with the new radars, although no decision has been made on a re-equipment program.

Corporal used as a target emerged from behind mountains that lay between its launch site and the Hercules launch site. It was killed on the downward portion of its trajectory. Army was not allowed to reveal the altitude of the kill nor the Corporal's speed at the time of the kill.

High-speed photographs of the test show Hercules approached the target from above. Army said Corporal did not follow programed course, and a new intercept plan had to be fed into Hercules while it was flying. Hercules detonated in proximity of the target on ground command, and resultant fragmentation caused the target to explode. Corporal was not fired on its maximum 75-mi. trajectory.

Hercules launch was conducted by Army, Bell Telephone Laboratories and Douglas Aircraft Co.



NIKE HERCULES solid-propellant radar-guided air defense missile destroys a Corporal guided ballistic missile. Hercules is on top with the Corporal directly below.

Vega Study Shows Early NASA Problems

By Evert Clark

Washington—The 11 month history of the Vega space vehicle program provides a management case study of the early problems National Aeronautics and Space Administration faced in establishing the national space booster program and of the agency's mixed success in meeting them.

Vega's history is a story of inexperienced management, interagency jealousies, the long delays inherent in government decision-making and the great influence of Soviet space achievements on U.S. actions. The bare outline of this history is in a brief report prepared by General Accounting Office for the House Science and Astronautics Committee. It provides the framework for this study.

The space agency put an end to the development of the Vega space vehicle last December (AW Dec. 21, p. 18), saying that similar payload capability and availability of the Air Force-developed Atlas-Agena B vehicle—plus the reliability to be gained because two agencies would use it—made the Agena B more desirable.

NASA left the impression that it had made its own decision to cancel the Vega, although this was not the case. NASA did not indicate that development of Agena B was begun later than development of Vega, and without NASA's knowledge—although this was the case.

Neither NASA's explanation of the cancellation nor the GAO report related any of the various steps in the two development programs to Soviet developments, but AVIATION WEEK has learned that they had considerable influence on a number of the decisions affecting both Vega and Agena B.

Although NASA was not created until Oct. 1, 1958—a year after the first Soviet Sputnik was put into orbit—designs already were being drawn in a number of government offices and industrial plants for vehicles that would provide a high space payload capability with a minimum of new development.

NASA first conceived the Vega in October, 1958. The vehicle was to use the USAF-Convair Atlas as a booster, a modification of the Navy-General Electric Vanguard first stage engine as a second stage, and a 6,000-lb. thrust nitrogen tetroxide-hydrazine engine then under development by California Institute of Technology's Jet Propulsion Laboratory as the third stage.

At first, interest in Vega was not very great, even though it looked as if it might be ready for flight in a shorter time than most proposed large boosters.

Centaur Approval

Defense Department's Advanced Research Projects Agency had just approved development of the Centaur, which used an Atlas booster and a liquid hydrogen upper stage. ARPA had compromised the program to fit available funds, and NASA was being urged to put money into Centaur instead of Vega.

This would have required NASA to gamble on the unknown development problems of the first hydrogen engine, wait through a longer development period and bide its time still longer while prior military demands claimed the first Centaurs.

The event that finally gave birth to the Vega program was the Soviet launching on Jan. 2, 1959, of Lunik I, the first rocket from earth to pass near the moon and go into orbit around the sun. NASA had mentioned the Vega, though not by name, in a planning meeting of 44 civilian and military space officials on Dec. 15, 1958, as one of a family of vehicles of the type NASA would like to see developed.

After Lunik, however, events moved swiftly. NASA urged the contractors involved to push their work vigorously. GE was allowed to charge for costs without a formal contract from Jan. 5 onward. Convair made a formal proposal for the Vega stage and GE proposed the engine for it Jan. 15. By Jan. 27, in a report prepared for the President by NASA's propulsion staff in consultation with ARPA, Vega was proposed as "the first general purpose vehicle of the national series."

Vega was planned for use from 1960 through 1964, and NASA said the vehicle could "boost two men into a close earth orbit with enough equipment to sustain them for several weeks. Its principal function, however, may be the exploration of the moon for which it is ideally suited.

"It should be possible in the next few years to take very high resolution photographs, first of the front or visible side of the moon and eventually of the back or heretofore unseen side," the report continued.

Russia took photographs of the back side of the moon seven and a half months later, after impacting a payload on the moon three weeks earlier. These two Soviet shots caused changes in the Vega program just before it was killed, just as Lunik I had precipitated the decision to develop Vega in the first place.

Vega also was described in the Jan. 27 report as "the first vehicle that can carry payloads of this magnitude to the vicinity of Mars or Venus, and [it] should pave the way for use of Atlas-Centaur which is better adapted to the

Scheduled Vega Launchings

	Apr. 4, 1959	Slippage	July 24, 1959	Slippage	Aug. 10, 1959	Slippage	Nov. 12, 1959	Aggregate Slippage
Vehicle 1	Aug. 1960	4 mo.	Dec. 1960	1 mo.	Jan. 1961	2 mo.	Mar. 1961	7 mo.
Vehicle 2	Oct. 1960	"	Feb. 1961	2 mo.	Apr. 1961	1 mo.	May 1961	"
Vehicle 3	Dec. 1960	"	Apr. 1961	3 mo.	July 1961	"	Aug. 1961	8 mo.
Vehicle 4	Feb. 1961	"	June 1961	4 mo.	Oct. 1961	"	Nov. 1961	9 mo.
Vehicle 5	Apr. 1961	"	Aug. 1961	5 mo.	Jan. 1962	7 mo.	Aug. 1962	16 mo.
Vehicle 6	June 1961	"	Oct. 1961	6 mo.	Apr. 1962	6 mo.	Oct. 1962	"
Vehicle 7	Aug. 1961	"	Dec. 1961	7 mo.	July 1962	.....	.....	Canceled
Vehicle 8	Oct. 1961	3 mo.	Jan. 1962	8 mo.	Oct. 1962	.....	.....	"

Source: General Accounting Office.

planet mission." Centaur was due to be available to NASA in the period from 1962 through 1966 and to have 50 to 100% more payload capability.

GAO's report makes a point of the fact that Defense told NASA sometime in the December 1958-January 1959 period that it had no interest in Vega, although the underlying philosophy of the NASA vehicle program was to use as few vehicle types as possible and to have them fired as many times as possible to gain higher reliability. NASA did not consider use by both agencies essential to success of the Vega program.

GAO also showed great interest in the origin of the Agena B program and implied strongly in its report that Defense and the Air Force initiated the Agena B development almost immediately after the year-end talks with NASA about Vega, but without telling NASA what it was doing. This development involved doubling the thrust of the Lockheed-Bell Agena stage, adding restart capability and changing the guidance system.

House committee Chairman Overton Brooks (D.-La.) asked GAO on Apr. 19 of this year to furnish all the information it could on the Vega cancellation by Apr. 22. GAO took only one week to prepare its report but said the results were a "product of review work begun in January 1960 on certain aspects of the national launch vehicle program."

Lack of Communication

Although the report puts considerable emphasis on the conclusion that Agena B was being developed almost concurrently with the Vega, it states that GAO could find no evidence that anyone told NASA of the Agena B program's existence until late summer of 1959.

Industry sources contend that the Agena B was not fully approved and considered a going development until the fall of 1959. The GAO report notes, however, that as early as Jan. 16 of that year—one day after Convair and GE made their formal Vega proposals to NASA—USAF's Ballistic Missile Division issued a contract change to Lockheed which included initiation of a "study and test program to investigate parameters and methods required to provide a restart capability" for the engine used in Agena. The program was to include preliminary design and an altitude test program, GAO said.

On Apr. 10, 1959, ARPA ordered Air Research and Development Command to "modify the Bell-Hustler Agena A stage to obtain dual burning capability, simplify guidance and control system, structural simplification such that pay loads of arbitrary shapes may be carried, and increased carrying capacity." At that time, a 60% tankage increase was contemplated. By early June, ARPA, BMD and Lockheed had agreed to double the Agena A tankage.

Still NASA had no official knowledge of the Agena B plans, according to what NASA officials told the GAO investigators.

". . . Development of the two rocket vehicles did not represent the calculated pursuit of two alternative approaches to better ensure success," GAO said. "There was no evident communication by the Department of Defense to NASA of planning for Atlas-Agena B."

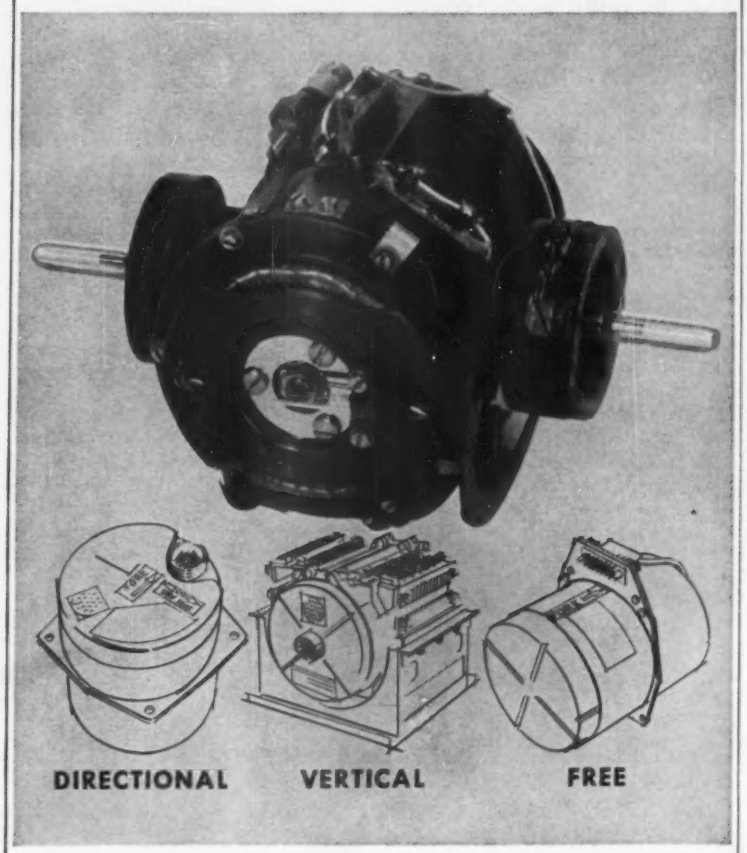
The Agena stages were being developed by BMD and its contractors as a part of the WS-117L early warning and reconnaissance satellite programs.

Early Agenas were being flown in the Discoverer series, boosted by Douglas Thor missiles to develop vehicles and techniques for WS-117L, NASA's Mercury man-in-space project and other space programs.

It can be assumed that ARPA and Air Force eventually might have needed a restart capability in the Agena for its use in the Midas and Samos satellite programs, and that initiation of a stage

Minuteman Lowered in Silo for Tethered Firing

Minuteman intercontinental ballistic missile test vehicle is emplaced in a silo at Edwards AFB, Calif., for a tethered launching conducted by Boeing Airplane Co. for USAF to ascertain the feasibility of single-hole silo installations for launching. All objectives of the test program were achieved after firing 8 of 18 scheduled tethered Minuteman test vehicle shots. This reduction in test launchings saved USAF $20 million, according to Boeing.



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with the capabilities of the Agena B could have been a logical step in the development program.

But the initiation of the changes in the Agena stage, without consultation or notification to NASA, was interpreted by industry sources familiar with the Agena program as indicative of a desire on the part of Defense and USAF not to have a new civilian agency demonstrate a technical capability in space that USAF itself had not yet demonstrated. GAO obviously shares that opinion.

NASA, meanwhile, was demonstrating an ignorance of the problem of launch facilities that it has since overcome, and an optimism with regard to development flight testing that it had to reverse within three and a half months after its first Vega flight schedule was formed.

GAO said its report made allowances for the fact that NASA was only formed on Oct. 1, 1958, and "of course, had no experience as an organization in managing large development programs," and for the fact that "space programs could be expected to encounter unforeseen engineering problems." But GAO concluded that "the events which finally overcame the Vega program are not entirely explained or justified by the general circumstances existing in 1958 and 1959."

Schedule Slippage

The Vega program lasted only 11 months. Within seven of those months, NASA revised its launch schedule at least three times, collecting an aggregate slippage in launch times ranging from seven months to 16 months in the first six vehicles (see table). Vehicles seven and eight had been canceled at least a month before the decision was made to abandon the whole program.

The first schedule, formulated on Apr. 4, 1959 called for launchings to begin in August, 1960, and continue at two month intervals through October, 1961.

This schedule already was four months off target when it was created because NASA had failed to make satisfactory arrangements with Air Force for launching facilities, GAO said.

As early as Feb. 11, 1959, BMD Commander Maj. Gen. Bernard A. Schriever had written to USAF Chief of Staff Gen. Thomas D. White recommending another Atlas stand at Cape Canaveral, Fla., to handle USAF, ARPA and NASA needs. This request should have included the needs of the Vega program, which USAF already was aware of, although later events indicate it did not take Vega into account.

Three months later, Defense Department's Ballistic Missile Committee

Comparison of GE Engine as Designed For Vanguard and Vega

Thrust		
Sea Level	27,835 lb.	23,500 lb.
Vacuum	30,400 "	35,140 "
Specific Impulse:		
Sea Level	248 sec.	204 sec.
Vacuum	270 "	305 "
Burning Time	150 "	243 "
Nozzle Expansion Ratio	5.5:1	25:1
Chamber Pressure	616 psia.	616 psia.
Number of Restarts	0	2
Propellant	Liquid oxy./ kerosene	Liquid oxy./ kerosene

Source: General Accounting Office.

approved the additional Atlas stand. A contract was entered into on June 10 —four months after the recommendation was made to Gen. White.

Construction of an Atlas pad requires 18 months, which meant the new pad could not be used for a launching until December of 1960, four months after NASA had planned to launch its first Vega.

GAO said it was told that NASA and BMD met as early as January, 1959, to consider Vega launch facilities, but GAO could not find any documents relating to the meetings or any correspondence dated earlier than May 14, 1959, in which NASA officially notified BMD of a firm proposal for Vega launch dates.

This notification was a teletype from NASA to BMD asking it to quote a fixed price for eight modified Atlas missiles for delivery at the Cape "at the rate of one every two months starting June 1, 1960."

BMD "took sharp issue" with this request in its May 23 reply, GAO said. It said that it could deliver the boosters but this "cannot, repeat, cannot be construed as an indication of Air Force launch stand capability for the Vega program. It is strongly recommended that a meeting be held at BMD in the near future . . . to discuss Atlantic Missile Range Atlas launch stand capability and arrive at a mutually agreeable and supportable launch schedule."

On June 19, 1959, BMD sent another teletype pointing out that December, 1960, was the first possible launching date for Vega, calling attention to the "15 month Atlas booster lead time required," and asking NASA to re-issue its procurement request to allow for these factors.

"Any booster delivery schedule which is based on an earlier launch date is not considered realistic or acceptable from a booster programing standpoint," BMD concluded.

On July 24, 1959, NASA revised its Vega schedule to reflect the launch pad problem. Seventeen days later, on Aug. 10, NASA revised the schedule for the second time, slipping the first launching by one month and separating all subsequent launches by three months instead of two. This "delayed the launching of the eighth vehicle an additional nine months," GAO said.

This rescheduling stated no reason for increasing the cycle from two to three months, but GAO said NASA has explained since that "the basic reason was that it was overly optimistic to schedule development launchings of a new, complex vehicle at two-month intervals from a single stand. The additional time for such a vehicle is necessary for the study of the data from each shot and for making the indicated modifications to the succeeding vehicle."

Third Schedule

Three months later, on Nov. 12 of 1959, a third Vega schedule was drawn. It slipped the first shot by another two months, the second, third and fourth by an additional month each, the fifth by seven months and the sixth by six months. Vehicles seven and eight were canceled.

The slippage in shots five and six had been gradual. An interim JPL schedule, prepared on Oct. 20, showed the launching of vehicles five and six in June and September, 1962, which already represented a slippage of five months from the August schedule.

"The best information we have," GAO said, " is that this delay resulted from an NASA decision to change the missions of these vehicles from a satellite and a space probe, respectively, to 'lunar orbiters.' The two-axis guidance system used in vehicles one through four could not be used in the 'lunar orbiter' missions, and it was necessary to allow time for development of a more complex, three-axis system."

What the GAO report does not point

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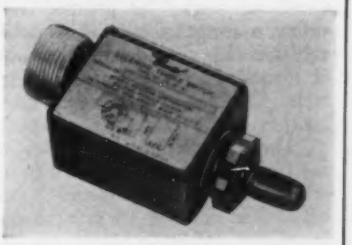

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out is that between the formulation of the August schedule and the Oct. 20 change in missions for vehicles five and six, Russia had impacted one payload on the moon (September) and photographed the moon's backside with a lunar orbiter of its own (launched Oct. 4).

JPL had for some time been pressing for a space program that included more space "spectaculars"—sound scientific experiments, but nevertheless experiments which took account of Soviet achievements and the loss in prestige they were costing the U. S.

NASA headquarters, on the other hand, had been much more inclined to shy away from a "reaction" approach to Soviet space shots, insisting instead on pursuing a program that was planned and orderly, regardless of what Russia might do.

Mission Switch

Whether the switch in missions immediately after the two moon shots represented a prevailing of JPL's point of view over the more conservative approach is not known. But, since JPL had systems management responsibility for Vega as well as most of the payload assignment mission, it is considered quite likely that that is what happened.

Sometime before Nov. 9, 1959, NASA and JPL personnel decided to cancel the last two Vega shots and buy other Vegas in 1963 only if Centaurs were not ready.

"It also was decided that the Vega would no longer be planned as providing a two-stage satellite capability" and that JPL should prepare a new set of missions for the six remaining vehicles, GAO said. This apparently was another result of Soviet competition.

"The cancellation of vehicles seven and eight appears to have been in recognition of the accumulated slippage, which had reached 16 months for vehicles five and six; a knowledge of the Atlas Agena B development; and the anticipated availability of Centaur," the report said.

As reported exclusively by AVIATION WEEK at the time of the final program cancellation (AW Dec. 21, p. 18), the Civilian-Military Liaison Committee and the National Space Council had discussed the competing systems before cancellation. This resulted in the Council's order to Glennan to end the Vega program.

CMLC Chairman William Holaday wrote memorandums dated July 19, 1959, to NASA Administrator T. Keith Glennan and to the Secretary of Defense proposing that Holaday's staff review the national launch vehicle program, GAO found.

On Sept. 8, Holaday informed the committee that the review was in progress. On Sept. 30, he submitted a memo to Glennan and to Defense in which the major recommendation was cancellation of the Vega second stage and its replacement by the Agena B. The House space committee was refused a copy of that memo on the grounds of executive privilege, but GAO obtained minutes of an Oct. 13 meeting of the CMLC which refer to the memo.

The minutes give the first indication that the JPL 6,000-lb. thrust engine was planned for use in the NASA version of the Atlas-Agena vehicle. Although NASA has indicated several times that limited development of the JPL engine is continuing to advance the state of the art and for possible space use, it has not officially linked this engine to its use of the Atlas-Agena. Payload comparisons presented to CMLC before Vega was canceled contemplated use of the JPL engine as a third stage on the Atlas-Agena.

The JPL engine is to have a specific impulse of 303 sec., a nozzle expansion ratio of 20:1 and a burning time of 250 sec.

There is no indication as to when Holaday first became aware of the parallel development of the Vega and Agena second stages. Although he obviously considered them an instance of duplication, many industry observers regard them as having been no more so than the Atlas and Titan intercontinental ballistic missile programs, in which billions of dollars have been or will be spent to ensure that at least one ICBM was available when such a weapon was needed.

Although the GAO report does not say so, Air Force initiated the comparison studies that showed Atlas-Agena had almost as much payload capability as the Vega vehicle. It also was USAF that pressed for consideration of the two vehicles by the CMLC and the space council, with the obvious intention that one should be canceled.

One of the strongest arguments advanced for the Agena B combination was that it had almost as much payload capability but with less weight. The difference, however, is some 12,000 lb. in 300,000 lb., or 4%.

Cost would not seem to be too great an argument in favor of using the Agena stage, either. The Agena B development cost could have been written off partly to earlier development of the Bell Hustler engine to power pods for the Convair B-58 bomber, and partly to the engine's use as the Agena A powerplant in the Discoverer series. The GE Vega engine's development cost could have been written off partly to the Vanguard program. Both have good records, the GE engine as a first stage powerplant for Vanguard and the Hustler engine as a Discoverer second stage.

GAO found that the cost of the Vega program would have been $91.6 million if it had been carried through launching of eight vehicles. The agency found the cost of completing and launching eight Atlas Agena B vehicles to be $76.1 million, although it said it worked from imprecise information and it apparently did not include cost of JPL engines, which as far as can be determined would have been necessary to carry out the revised Vega missions.

Thrust of the GE engine as modified for use in the Vega is 35,140 lb., with a burning time of 243 sec. and a specific impulse of 305 sec. Specific impulse and thrust of Agena B are classified, but it can be assumed from the doubling of tankage and use of the same fuels as in Agena A that total impulse is doubled.

Cost Comparisons

Cost breakdowns for the two programs as reported by GAO, and apparently ignoring payload cost, are:

- **Vega–Atlas boosters,** $20 million; Vega stage, $36 million; GE engine, $6.1 million; JPL stage and systems management, $25.5 million; range costs $4 million. Total, $91.6 million. Source was NASA information submitted to GAO on Apr. 20, 1960. NASA said at the time Vega was canceled that $65 million had been programed through Fiscal 1960.
- **Agena B stage only**—Engine restart capability, $2.3 million; increased tankage, $1.7 million; vehicle and guidance changes, $850,000; checkout, $300,000. Total, $5.15 million. Source was an amendment to an ARPA order. The amendment was dated Apr. 19, 1959, and costs probably have increased since then.
- **Atlas-Agena vehicle**—Atlas boosters, $16.8 million; Agena B stage, $12.8 million; ground support equipment, $7 million; operations, $15.8 million; facilities, $800,000; base support, $1.8 million; tracking and communications, $2.4 million; costs pro rated from an over-all total for Thor-Agena Bs and Atlas-Agena Bs to the Atlas-Agena B program only $18.7 million. Total, $76.1 million. Source is a report, dated Feb. 15, 1960, by a NASA survey team which estimated the cost of a 12-vehicle program consisting of eight Atlas-Agenas and four Thor-Agenas. There is no indication of whether the JPL engine is still intended for use on top of either vehicle, or whether the cost of this engine development is included in this estimate.

GAO said that actual costs of the Vega development work that preceded cancellation have not been determined. Last Jan. 27, Glennan estimated them at $17 million, some part of which would be recovered in the Centaur program. The Fiscal 1961 budget justifica-

tion put them at about $18.3 million. On Apr. 1, NASA gave GAO an estimate of $15.9 million, of which $2.6 million would be recoverable in other programs, leaving a net estimated cost of $13.3 million.

This net figure apparently does not consider all costs incurred by JPL, however, according to GAO.

"This estimate includes $3.2 million as 'estimated net obligations [for JPL] for which cash disbursements have been or will be made.' Costs recorded on the books of JPL at Dec. 31, 1959 under 17 Vega vehicle job numbers total $6.09 million," GAO said.

Development slippage, the usual scapegoat for a delay in vehicle programs, is excused from blame by GAO in the Vega program, which is in itself a tribute to an agency that was new when it began the Vega program.

The major blame for the cancellation of Vega, according to the GAO report, lies not so much in NASA's early ignorance of the criticalness of the lack of launch facilities as in the simple fact that not enough launch facilities existed in the U.S. to support "an intensive space exploration program."

Even if Vega had been continued, the construction of Complex 36 at Cape Canaveral to handle the vehicle could not have been completed before December, 1960—four months after NASA had hoped to launch the first Vega. And the pad had to be built to handle Centaur and other programs, regardless of Vega.

This does not, of course, explain why it took four months from the time that an extra Atlas pad was requested to get approval and to execute the contract for its construction.

GAO noted that three factors determine availability of a vehicle for use in the civilian space program:

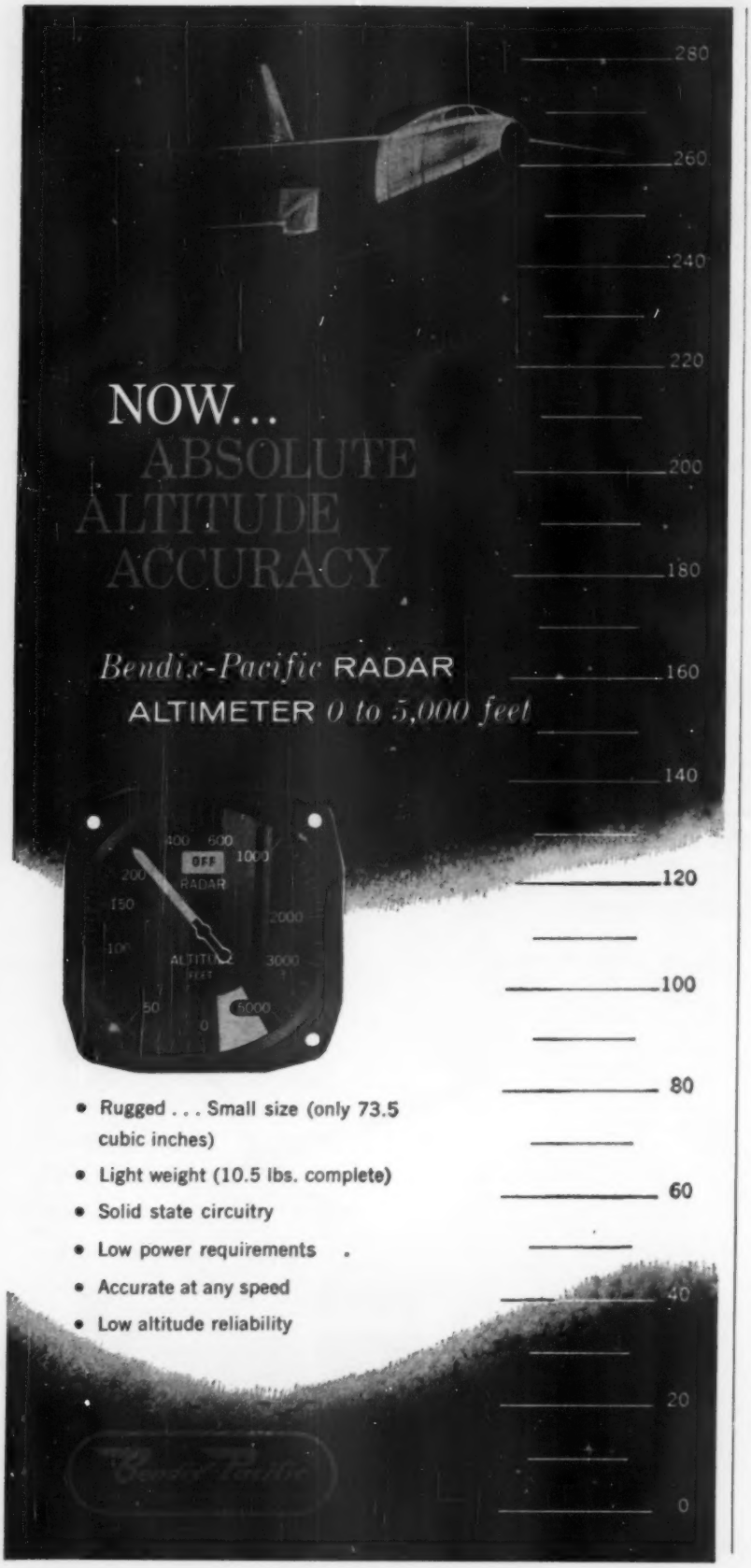
• **Development.** Both Vega and Agena B were progressing normally when Vega was canceled.

• **Launch pads.** Pads 11 and 13 at Cape Canaveral were scheduled for Atlas research and development launchings. Pads 12 and 14, the only other Atlas pads, were the only two equipped to handle launching of multistage, Atlas-boosted vehicles and, according to GAO, they were already booked in the spring of 1959 "for full-time use until 1961 in the Atlas research and development program, the man in space program, and the [deleted]." Presumably, the deletion referred to the Midas early warning satellite program, for which one of the two modified Atlas pads has since been used.

Agena B will be launched initially with Thor boosters, presumably from Pacific Missile Range sites. Whether it will be launched from Pad 12 or 14 at the Cape when it moves into its Atlas-boosted phase, or whether it will have

Bullpup Launched From Marine Corps HUS-1

Navy-Martin Bullpup radio-controlled missile is fired from a helicopter for the first time at Naval Air Test Center, Patuxent River, Md. The 12.5-ft.-long, 570-lb. missile is being launched from a Marine Corps Sikorsky HUS-1 flying at 500 ft. altitude and 90 kt. forward speed. No stability problems were encountered, and control of the missile was no more difficult than from a fixed-wing aircraft, according to the pilot, Marine Corps Maj. L. L. Harpe. On this shot the Bullpup landed about 20 ft. short of the target, an orange disk 10,000 yd. away in Chesapeake Bay. The pilot guided the missile to the target by moving a switch on the control stick up, down or sideways. Flares on the Bullpup's aft section enable the pilot to visually track the missile. Photo below shows how Bullpup is attached to a Martin-built rack and mounted on a tubular structure designed and installed by Sikorsky on the HUS-1.



to wait for completion of the new Complex 36, just as Vega would have had to, is not known.

• **Existence of other** programs which require first use of the vehicle. NASA did not face this problem with Vega, since Defense had long ago indicated no interest in the vehicle. But NASA does face this problem with Agena B. Although both vehicles were to be through development before Complex 36 could have been ready, "prior claims of Department of Defense programs" meant that "Atlas-Agena B vehicles could not be made available to NASA for launching before February of 1961," GAO said.

Glennan told the House committee on Jan. 27 of this year that Vega had been canceled for four reasons:

• **Demonstration** by Defense of significant reliability in the Thor-boosted Agena A stage. The GE engine also had demonstrated a high reliability in the Vanguard program. Although it had never been started at altitude, as the Agena A stage had, this is not as large a problem as restart, which neither engine had at that time. Agena B, incidentally, has not yet been flown to demonstrate this restart capability.

• **Decision of Defense** to uprate the Agena to the point where payload capability approached that of Vega. Glennan did not take note of the fact that this decision came after NASA's decision to uprate the GE engine.

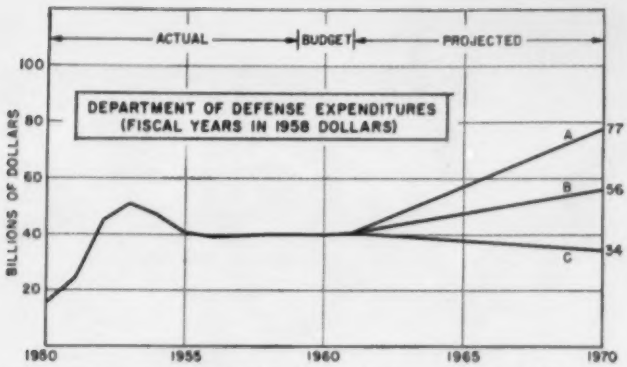
• **High firing rate** of Agena systems on Thor and Atlas, "thus promising greater reliability." This point cannot be disputed, since both Agena A and Agena B will experience a number of firings by Defense, whether NASA uses them or not.

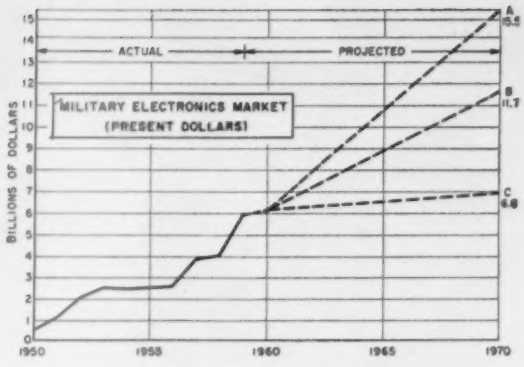
• **Agena B availability** "approximates that of the Vega." The difference, considering launch pad problems, was approximately two months, and the difference favored the Vega.

Vega was, as GAO observed, an interim, general purpose vehicle, based on an underlying booster program philosophy of a great number of firings of a few types of vehicles to ensure reliability.

"The disinterest of Defense Department in Vega sharply limited the opportunity for extensive interim use," GAO said. "As an interim vehicle, sandwiched between a tight development schedule and the oncoming Centaur, there was little margin for program slippage."

Thus the Vega, a victim of NASA's apparent failure to appreciate the exigencies of launching facility planning, a long, unexplained silence on the part of the Agena B planners, and the pressures of Soviet space achievements, had to be canceled or become "an example of the situation NASA intended it to correct."





PROJECTED outlays will be highest in limited war (A); in middle in cold war (B); lowest if arms control prevails (C).

Electronics Spending Forecast for 1970

New York—The United States' total defense electronics market may grow from the current $6 billion to $11.7 billion in 1970 if the nation maintains its cold war status, according to John J. Rutherford, director of long range planning, Sperry Gyroscope Co.

If, in 1970, the United States is engaged in a limited Korea-type war, Rutherford told the National Federation of Financial Security Analysts Society here, the military electronics market may go as high as $15.4 billion. On the other hand, a state of arms control in 1970 might appreciably limit the military electronics market to a figure of $6.8 billion.

The gross national product may rise from the present $427 billion to $788 billion in 1970 if a limited war is being waged at that time. If the status quo cold war situation exists, gross national product may be $747 billion, and if arms control is in force the GNP may be $708 billion.

From these gross national product figures Rutherford extrapolates total Department of Defense expenditures for 1970 as follows:

- **Limited war**—$77 billion.
- **Status quo**—$56 billion.
- **Arms control**—$34 billion.

In making his estimates Rutherford takes the position that a limited war would last one or two years and that military forces would increase to Korean War levels.

By disarmament he means the banning of nuclear tests, prohibition of the use and manufacture of nuclear weapons, a deduction in U. S. armed forces by about 1 million men, an across-the-board cut in the defense budget, and the existence of control and inspection measures.

Rutherford defined the status quo situation as one which is similar to current conditions, including maintenance of current armed forces strength of 2½ million men.

A forecast of the total industrial electronics market in 1970 also was made by Rutherford, as follows:

- **Limited war**—$6.57 billion.
- **Status quo**—$6.27 billion.
- **Arms control**—$5.84 billion.

Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Holdings for the period Apr. 11 to May 10, 1960, reported the following transactions by three executives of American Bosch Arma: acquisition of 500 common shares through exercise of option and disposition of 1,100 common shares by David F. Devine, officer, leaving a holding of 1,080; disposition of 10,000 common shares by Charles W. Perelle, officer and director, leaving a holding of 10,000; disposition of 700 common shares by Harold R. Sennstrom, officer, leaving a holding of 405.

Other transactions for the period Apr. 11 to May 10 include the following:

Aeronca Manufacturing Corp. Acquisition of 500 common shares by C. G. Felix, officer, making a holding of 710; acquisition of 100 common shares by Walker W. Rutledge, officer, making a holding amounting to 100.

American Airlines, Inc. Acquisition of 1,000 common shares by C. R. Smith, officer, making a holding of 26,000.

Ampex Corp. Disposition of 1,500 common shares by T. Kevin Mallen, director, leaving a holding of 54,000; disposition of 3,750 common shares (150 shares as a gift) by Henry A. McMicking, officer and director, leaving a holding of 63,485; acquisition of 750 common shares through exercise of option by Robert L. Pappas, officer, making a holding of 789; disposition of 3,000 common shares by A. M. Poniatoff, director, leaving a holding of 5,550.

Bendix Aviation Corp. Acquisition of 125 common shares by Russell D. O'Neal, officer, making a holding of 204; disposition of 1,200 common shares by Arthur E. Raabe, officer, leaving a holding of 60; disposition of 314 common shares, his total holding, by C. C. Tillinghast, Jr., officer and director.

Boeing Airplane Co. Acquisition of 42 common shares as compensation by George S. Schairer, officer, and disposition of 897 common shares, leaving a holding amounting to 342.

Cessna Aircraft Co. Disposition of 15,000 common shares by D. L. Wallace, officer and director, leaving a holding of 133,557.

Douglas Aircraft Co. Disposition of 1,000 capital shares by Edward H. Heinemann, officer, leaving a holding of 3,020; disposition of 600 capital shares by Edward H. McLaughlin, director, leaving a holding of 400; disposition of 1,000 capital shares, his total holding, by Arthur E. Raymond, officer and director.

Eastern Air Lines, Inc. Acquisition of 500 common shares by Charles E. Daniel, director, making a holding of 1,010.

Fairchild Engine & Airplane Corp. Disposition of 525 common shares, his total holding, by Floyd S. Bennett, Jr., officer.

General Dynamics Corp. Disposition of 1,300 common shares by Frederic de Hoffmann, officer, leaving a holding of 2,430; disposition of 1,000 common shares by Vernon M. Welsh, officer, leaving a holding of 7,000; acquisition of 1,435 convertible preference shares by Lester Crown, officer, making a holding of 208,597 (indirect holdings in trust remain 42,057).

Grumman Aircraft Engineering Corp. Disposition of 10,000 common shares by Albert P. Loening, director, leaving 25,000 shares.

Litton Industries, Inc. Disposition of 200 common shares by Charles R. Abrams, Jr., officer, leaving a holding of 5,500; disposition of 3,600 common shares by Alfred B. Connable, director, leaving a holding of 8,000; disposition of 400 common shares by Lewis W. Howard, officer, leaving a holding of 6,900; disposition of 8,000 common shares by Myles L. Mace, director, leaving a holding of 8,685; disposition of 600 common shares by Carl A. Spaatz, director, leaving a holding of 5,400.

Lockheed Aircraft Corp. Acquisition of 100 capital shares by Aurelius B. Vosseller, officer, making a holding of 100.

The Martin Co. Disposition of 500 common shares by H. W. Merrill, officer, leaving a holding of 947.

McDonnell Aircraft Corp. Disposition of 100 common shares by Kendall Perkins, officer and director, leaving a holding of 596.

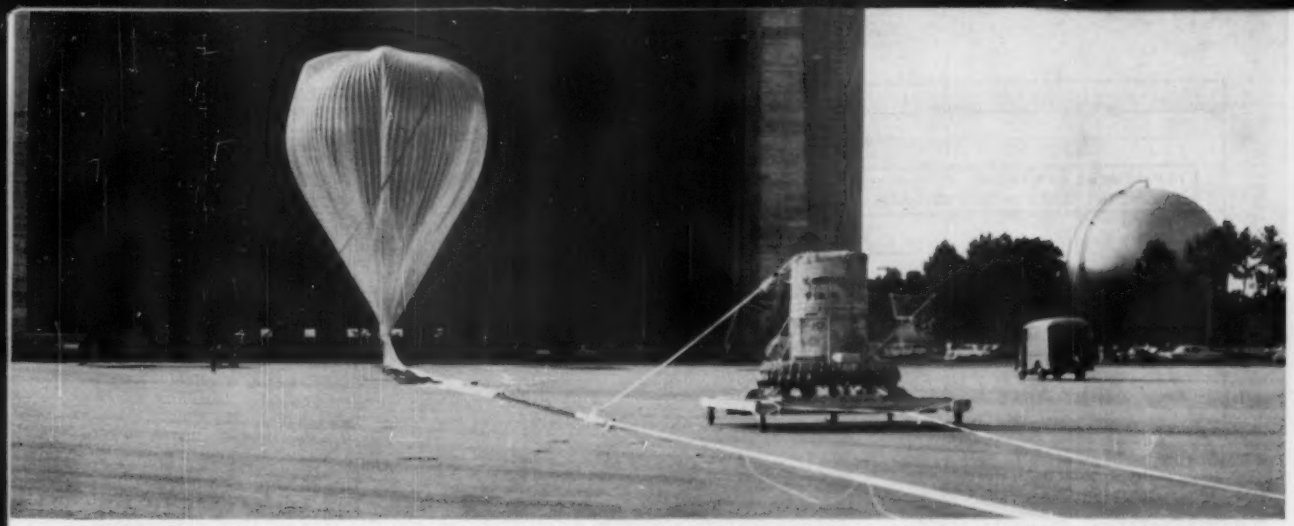
National Airlines, Inc. Disposition of 600 common shares by Edwin C. McDonald, director, leaving a holding of 14; disposition of 525 common shares by Paul R. Scott, director, leaving a holding of 2,000.

Northeast Airlines, Inc. Acquisition of 200 common shares by James W. Austin, officer, making a holding of 200.

Northwest Airlines, Inc. Acquisition of 1,100 common shares through exercise of option by Paul L. Benscoter, officer, and disposition of 1,000 common shares, leaving a holding of 900; disposition of 1,200 common shares by A. J. Weatherhead, Jr., director, leaving a holding of 50.

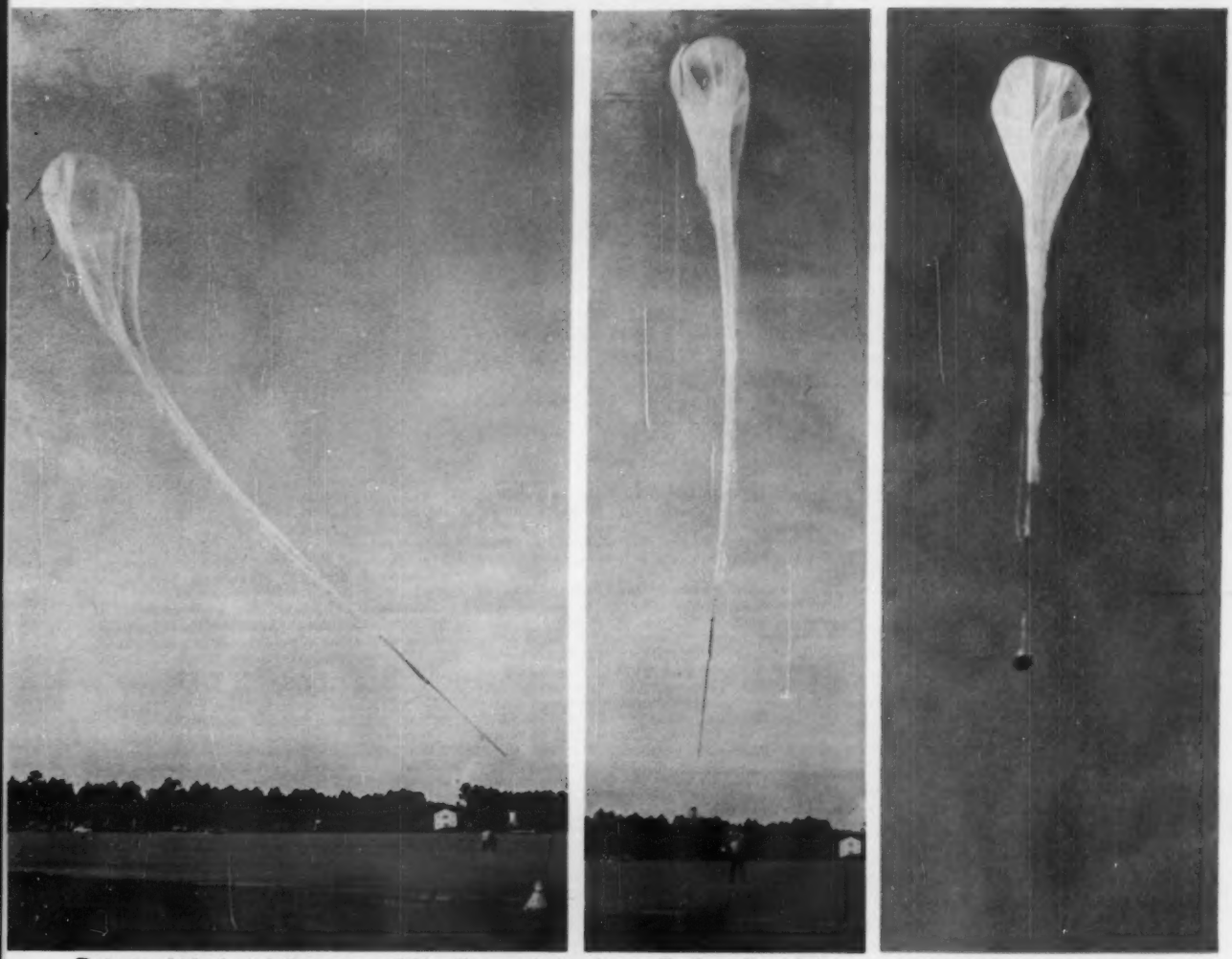
Piper Aircraft Corp. Disposition of 500 common shares by Norman J. Green, director, leaving a holding of 3,500.

Raytheon Co. Acquisition of 2,077 common shares by David R. Hull, officer, making a holding of 4,959 (indirect holding in trust remains 200); acquisition of 1,000 common shares by Richard E. Krafve, officer and director, making a holding of 3,050; disposition of 465 common shares by Robert L. McCormack, officer, leaving a holding of 1,000.



Search for "Skyhook" balloon, launched June 5 from U. S. Naval Air Station at Glynco, Ga., was abandoned last week. Last sighted 700 mi. west of Los Angeles, heading west at 10-15 kt., the balloon carried an 800 lb. stack of photographic emulsion to record interaction of ultra high energy cosmic ray particles (AW June 13, p. 37). Discovery by surface craft remained a possibility.

U.S. Navy 'Skyhook' Balloon Studies Cosmic Rays



Forty-story high plastic balloon measured 10 million cu. ft. in volume. Total weight, including the scientific load, control equipment and ballast was over 2½ tons, the heaviest load ever carried above 100,000 ft. by a balloon. Jointly sponsored by the National Foundation and Office of Naval Research, the study is being conducted by the University of Chicago.

SPACE surveillance control at Hanscom Field, Bedford, Mass., is one of 13 support system programs managed by newly-formed Command & Control Development Division of Air Research & Development Command. Center monitors all known space objects, computing their latest orbital data and status from world-wide optical and radar sightings which are channeled into the center.

USAF Reorganizes Avionic Management

By Philip J. Klass

Bedford, Mass.—Air Research & Development Command's newly formed Command & Control Development Division (CCDD), commonly referred to as "C-squared, D-squared," which will guide the development of USAF's complex electronic support systems, is taking form here at Hanscom Field near Boston, Mass.

The Air Materiel Command's counterpart organization, the Electronic Systems Center (ESC), also has set up shop here so that for the first time all of the USAF's electronic support system project offices (ESSPOs) are now located at a single site. (Formerly they were divided between Dayton, New York City and Bedford.)

Recognizing the growing importance of this area, a number of avionics systems manufacturers have begun to set up offices in the Boston area to maintain close liaison with CCDD and ESC.

Unlike ARDC's three other major divisions, which are largely extensions of previous organizations, CCDD is an entirely new organization as such although some of its elements existed previously as parts of other ARDC groups.

Even CCDD's assigned task is without extensive precedent. Electronic support systems are a development of the past decade, SAGE being the first. The bulk of the systems are of quite recent vintage.

Maj. Gen. Kenneth P. Bergquist, CCDD commander, concedes that "we've still got a lot of straightening out to do" before the new division's organization is in place and operating.

Existing Organizations

Four existing organizations will figure prominently in CCDD's operations, covering the technical spectrum from scientific guidance to advanced research to hardware development:

- **Mitre Corp.**, nonprofit company set up by the Massachusetts Institute of Technology, will provide qualified scientists and engineers to assist CCDD in technical management matters.
- **Lincoln Laboratory**, a tri-service-sponsored facility also operated by MIT, will serve as an advanced development laboratory.
- **Electronics Research Directorate**, part of ARDC's Research Division, will emphasize basic research in the electronics field, much of it applicable to CCDD's efforts.
- **Rome Air Development Center** will continue to develop and sponsor development of feasibility models and techniques required for new support systems or to improve existing ones. RADC will remain at Rome, N. Y., but will come under operational direction of CCDD in July.

Bergquist acknowledges that there is some overlap in the work areas of these groups. Some of it is necessary or unavoidable, he believes, as large electronic companies with decentralized divisions have discovered.

Time and experience should eliminate most of the unnecessary overlap, Bergquist says.

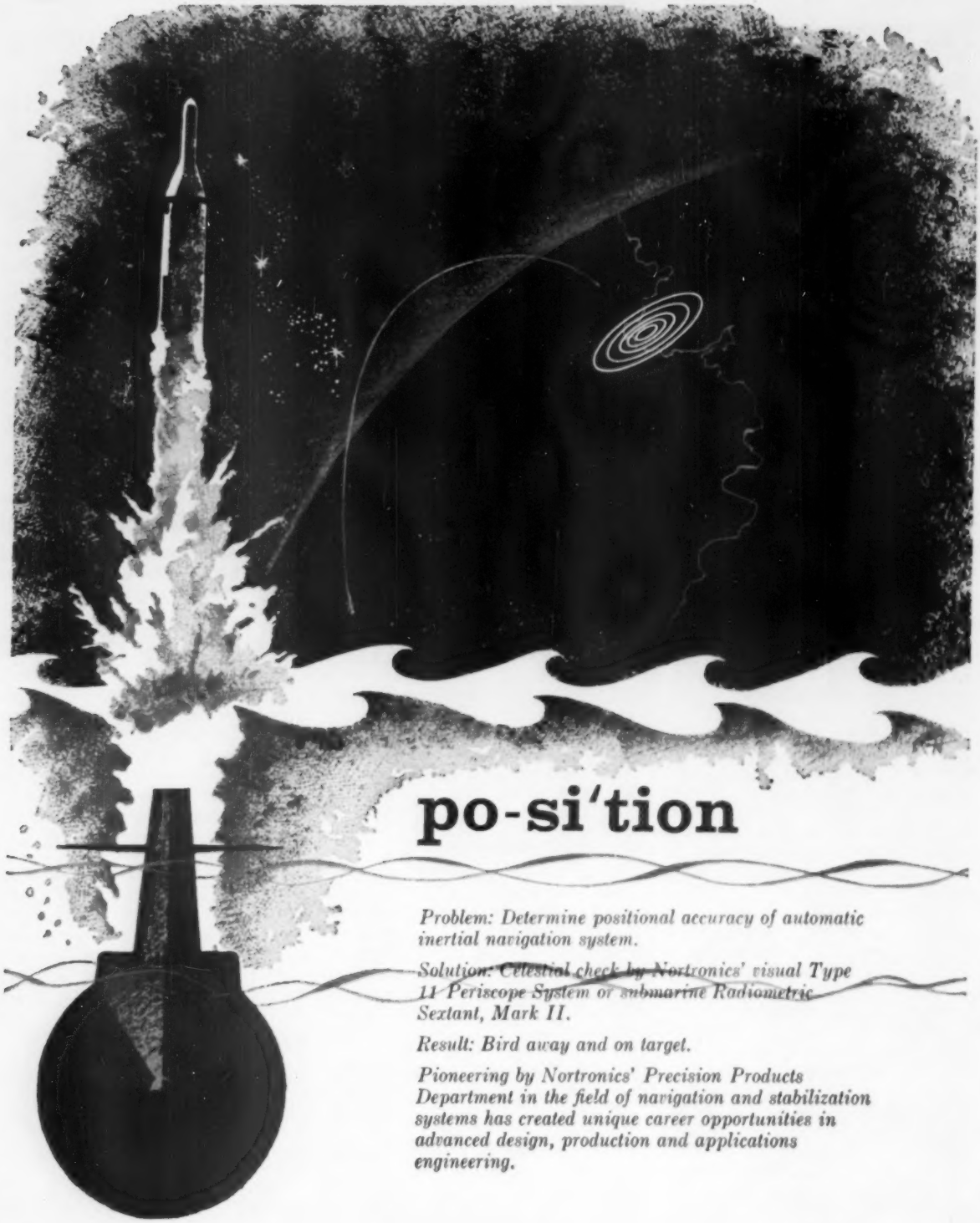
At present the Command and Control Development Division has about 300 civilian and military personnel, not counting support from the aforementioned organizations. The division is expected to grow somewhat, but Bergquist doubts that it will top 600-700 in the foreseeable future.

Basic Differences

The operations of CCDD are expected to differ somewhat from those of the Ballistic Missile and the Aeronautical Systems Divisions because of the basic differences between weapon systems and support systems.

Whereas a weapon system has a limited lifetime, then becomes obsolescent and is phased out of the operating inventory, a support system has an indefinite life because its performance can be continuously improved by modification and/or introduction of new elements to keep the system abreast of changing needs and give it an indefinite lifetime.

Because a new type airplane or mis-



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sile usually is a semi-autonomous weapon, there is relatively little need for coordination between the companies or agencies developing different weapons. Nor is it necessary to coordinate the performance characteristics of the new weapon with those of existing weapons which it will supersede, in most instances.

But because many of the support systems share common communications and/or display facilities, and often must communicate between themselves, continued coordination is required during their development to assure that the systems are mutually compatible.

Whereas a new weapon usually can be introduced into the inventory without directly affecting the existing inventory weapons, improvements in support systems must be designed so they can be introduced on an evolutionary basis without disrupting the system's vital service.

These inter-system integration problems, first encountered in the SAGE air defense program, are becoming increasingly important, and difficult, Gen. Bergquist points out.

In principle, the operational requirements drawn up by Air Force Headquarters and the user command should define the characteristics of the systems which CCDD develops. But the very nature of many of the support systems forces CCDD to investigate the operational aspects of its customer commands' business.

There is considerable precedent for this in the experience of companies that purchase large automatic data processing systems for application to their business operations. Companies find that all of their business procedures and methods, accumulated over the years, must be subjected to a penetrating operational analysis so that the program for the computer can be prepared. This analysis involves frequent questions such as: "Why do you do it this way?" and "Why do you need this information?"

Sometimes it turns out that a radical change in corporate procedures not only is required for computer operation but that it also improves over-all corporate operations.

This is the sort of operational analysis probing that CCDD must do if it is to give the Air Force the most effective and lowest-cost support systems, in the view of Gen. Bergquist.

Study Group

The Winter Study Group, formed six months ago to study the entire USAF support system requirements and current programs (AW June 6, p. 30), has found it necessary to probe into very basic concepts and questions, some of which extend beyond the limits of Air Force interests alone. For example, what will be the consequences of an all-out nuclear war on a nation's over-all military posture and what will be the nature of military operations following the initial all-out blow?

The Command and Control Development Division contains four directorates:

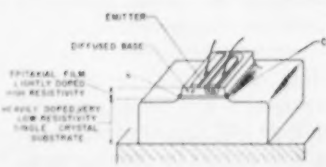
- **Directorate of Technology,** headed by Col. B. R. Lawrence, Jr.
- **Directorate of Systems Management,** under Col. William H. Congdon.
- **Directorate of Facilities,** headed by Col. Stephen F. Noonan.
- **Directorate of Procurement,** headed by W. J. Irwin.

The function of the Directorate of Technology is to manage applied research programs intended to establish the feasibility of new concepts and techniques for application to future systems. This directorate will monitor the system study and development programs being carried out by RADC, Lincoln Laboratory, Mitre Corp., USAF Research Division's Electronics Research Directorate here at Hanscom Field, and some work at Wright Air Development Division which has application to CCDD's systems effort.

Generally speaking, the Directorate of Technology will not itself make contract awards but will work through one of the support groups such at RADC or Lincoln Laboratory, according to Col. Lawrence.

Largest of the four CCDD directorates is the one for Systems Management which currently numbers about 200 military and civilian personnel and has an authorized strength of around 400. Here are located all the ESSPOs, or System Program Offices (SPOs) as Directorate Chief Col. Congdon prefers to call them. These include the following, with the CCDD officer in charge also indicated:

- 412-L: Air Weapons Control System;



Transistor Fabrication

New epitaxial film technique, which increases transistor switching speed by factor of more than 10:1 and cuts collector series resistance by comparable figure, uses extremely thin film (0.1 mil) of lightly doped, high resistivity semiconductor, instead of conventional thick crystal, for collector. Film has same single-crystal structure as the heavily doped crystal semiconductor substrate. Technique was developed by Bell Telephone Laboratories. BTL predicts the new technique will extend frequency response of germanium transistors well beyond 2,000 mc.

po-si'tion

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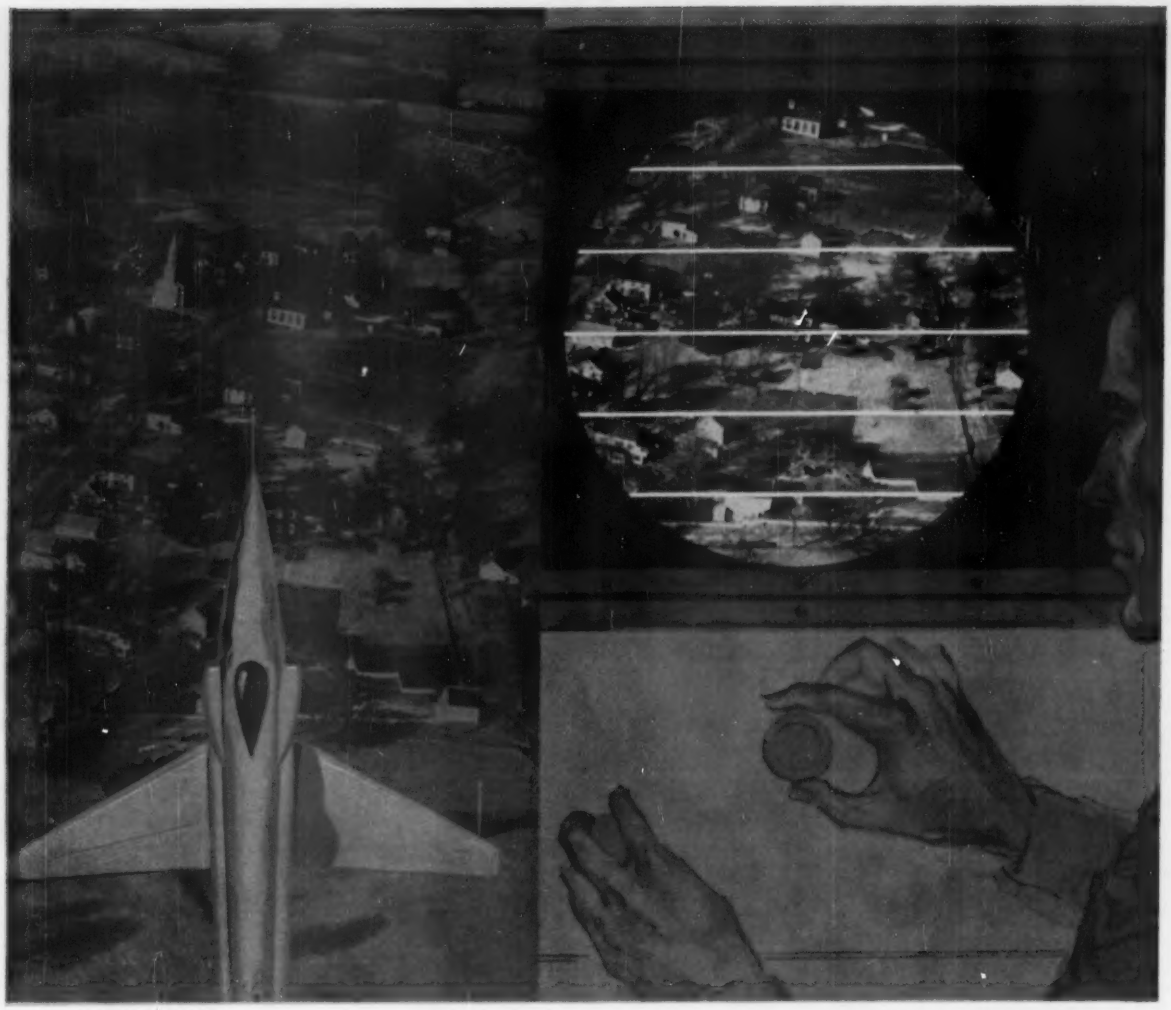

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Lt. Col. E. O. Jones, Jr.

• **413-L: DEW Line Extension;** Maj. John Thompson.

• **416-L: SAGE Air Defense System;** Lt. Col. Clayton F. Allen.

• **425-L Norad Combat Operations Center;** Col. Jay Jaynes.

• **431-L: Traffic Control and Landing System;** Col. William C. Adams.

• **433-L: Weather Observation and Forecasting System;** Col. George A. Guy.

• **438-L: Intelligence Data Handling Systems;** Lt. Col. William C. Dodds.

• **465-L: Strategic Air Command Control System;** Col. Daniel E. Riley.

• **466-L: Electromagnetic Intelligence System;** Lt. Col. James B. McKenzie.

• **473-L: Air Force Control System;** Col. Darrel J. Freund.

• **474-L: Ballistic Missile Early Warning System;** Col. Leo J. Skinner.

• **480-L: Air Communications System;** Col. Wayne L. O'Hern.

• **496-L: Space Surveillance Center;** Col. Victor A. Cherbak, Jr.

Executive management responsibility for three of the above 13 SPOs is held by AMC's Electronic Systems Center—413-L (DEW Line), 416-L (SAGE) and 474-L (BMEWS).

In organization of the new Systems Management Directorates, Col. Congdon has established four assistant directors, each of whom is responsible for overseeing the activities of three or four system program offices to assure compatibility of related systems and to resolve technical differences. These posts are as follows:

• **Intelligence Systems,** under Col. C. H. Morneau, is responsible for program offices for the Intelligence Data Handling System (438-L), Electromagnetic Intelligence Systems (466-L), BMEWS (474-L), DEW Line (413-L) and Space Surveillance Center (496-L).

• **Weapons Control Systems,** under Col. G. H. Duncan, is responsible for program offices for Air Weapon System (412-L), SAGE (416-L), Traffic Control and Landing System (431-L) and Weather Observation & Forecasting System (433-L).

• **Command Systems,** under Col. Daniel E. Riley, is responsible for program offices for SAC Control System (465-L), USAF Control System 473-L) and Norad Combat Center (425-L).

• **Communication Systems,** under Col. Wayne O'Hern, includes only the Air-Comm (480-L) program office, but O'Hern serves as the directorate focal point on communication problems and facilities which cut across the lines of interest of all other support systems.

A somewhat similar, but not quite identical, group of system project offices is employed by the AMC's Electronic Systems Center, headed by Maj. Gen. Clyde H. Mitchell. In ESC there are three systems management directorates instead of CCDD's four: Weapons Control Systems, Intelligence & Warning, and Command, Control & Communication Systems with the Air-Comm (480-L) office included in the latter instead of being separate as in CCDD.

The CCDD Systems Management Directorate also includes a modest-sized analysis engineering group, under Col. Jean A. Jack, which provides in-house technical support for the directorate. Most of this group's technical staff, which numbers around 25, came from the former Air Defense Systems Integration Division (ADSID).

The Systems Management Directorate also includes a Systems Test Division headed by Col. Herschel D. Mahon, which supervises field tests and evaluation of support systems.

Compounds Studied For Avionic Devices

Pittsburgh, Pa.—Growing emphasis on electronic devices made of compound semiconductors which are capable of operating at the high temperatures and high frequencies needed in military and space systems was reflected in topics explored here recently at the annual Solid State Device Research Conference.

H. L. Henneke of Texas Instruments, Inc., described a transistor made of indium antimonide developed at the company's Central Research Laboratories for the Navy. Potentially capable of operating well into the microwave region, in the kilomegacycle range, the device has current gains as high as 50 or 100 and has satisfactory frequency response around 200 mc. It must be cooled to liquid nitrogen temperatures.

Transistors made of another compound material—gallium arsenide—were reported by E. C. Wurst, Jr., of Texas Instruments and a group of engineers from RCA Semiconductor and Materials Division. Developed under Wright Air Development Division contract, the RCA transistor, previously demonstrated at Naecon, can provide 20 db. gains under matched conditions. The Texas Instruments gallium arsenide transistor has common emitter current gains up to 18. The latter device was developed for Navy Bureau of Ships as part of a contract calling for transistors made of compounds of the group three-five elements in the periodic table.

A number of reports on the physics of tunnel diodes was presented and an informally organized evening session devoted to airing ideas on the physics of the tunneling process and measurements of tunnel diodes was held.

Among other devices described in reports at the conference were:

• **Infrared detector,** made of copper-doped germanium, capable of detecting 10 nanowatts of radiant energy at 12 microns. Developed by Texas Instruments, this detector has peak spectral response at 23 microns and must be cooled below 20K.

• **Electroluminescent films** which can be used for low-level lighting of cockpit instrument panels, as storage displays or computer readout devices. Previous electroluminescent devices used powders suspended in a dielectric and were excited by alternating current. Work of W. A. Thornton of Westinghouse involves zinc sulfide films, excited by direct current, and capable of 600 to 700 ft.-lamberts of brightness at 80 to 90 volts. Zinc sulfide film electroluminescent devices, according to Thornton, offer equivalent brightness, better impedance matching and high discrimination ratios compared with a.c. electroluminescence.

• **Plasma semiconductor oscillator,** capable of generating frequencies from a few kilocycles to 10 megacycles, was described by R. D. Larrabee of RCA Laboratories. Device consists of a specimen of germanium, a centimeter in length and 1/10 cm. square subjected to a magnetic field and connected through a d.c. power supply to a load. Frequency of oscillation is then determined by the strength of the magnetic field, the strength of the electric field, the angle between the two and also the surface condition of the semiconductor.

FILTER CENTER

▶ **System Speeds Data Transmission**—New high-speed data transmission system, developed by Collins Radio, has gone into use between Douglas Aircraft's Nike manufacturing facility at Charlotte, N. C., and company computing facility at Santa Monica, Calif. Engineering problem data, formulated on punched cards, is transmitted from Charlotte at the rate of 200 cards per minute, equivalent to 3,000 words per minute, to Santa Monica. Computation is performed at night, on IBM 704 and 709 computers, and the answers transmittted back the following morning. Similar Collins system also has gone into use linking two Army Signal Corps supply points 650 mi. apart.

▶ **Navy Studies Expendable Modules**—Navy Bureau of Weapons is studying analysis by National Bureau of Standards which indicates that it would be as cheap to discard defective avionic modules as to repair them. Navy-sponsored NBS study also emphasizes that use of expendable module philosophy would ease maintenance, training and logistics problems. NBS analysis finds that optimum-sized module, on the basis of economy and maintenance convenience, is one that contains between four and

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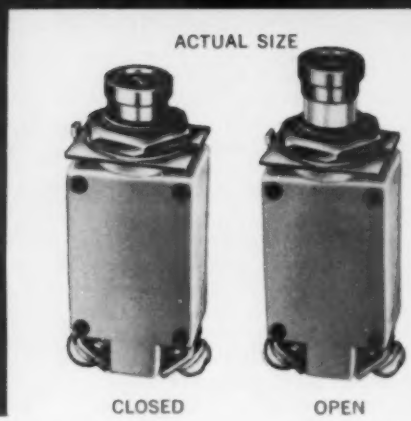

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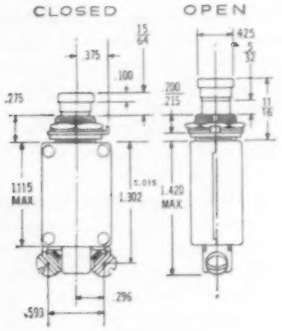

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eight tubes with related parts. Copy of the NBS report, entitled "Expendable Modules as Bases for Disposal-at-Failure Maintenance," PB-151400, can be obtained for $2.25 from Office of Technical Services, Department of Commerce, Washington 25, D. C.

▶ **Fiber Optics Reconnaissance System**—An aerial reconnaissance system which employs fiber optics, a principle by which light can be passed from one end of a flexible glass fiber to another and thereby enables images to be passed around corners, is one of many possible applications for this electro-optical technique being considered by RCA. Fiber optics could make possible high sensitivity, high signal-to-noise ratio systems with resolutions comparable to film.

▶ **Space Radar**—Advanced Electronics Center of General Electric's Light Military Electronics Department in Ithaca is trying to interest military agencies in its version of side-looking radar (AW Apr. 18, p. 94) for space applications. Company's SAHARA (Synthetic Aperture High Altitude Radar) is a low-power, high angular resolution radar. Through data processing techniques SAHARA manages to achieve the effect of large antenna size although actual antenna dimensions may not exceed 10 to 15 sq. ft. Larger synthetic antenna permits power and hence size reduction. Entire unit, including necessary data processing weighs 150 to 200 lb.

▶ **Countering ICBMs**—Feasibility of putting tracking radar into space to follow ICBMs after burnout is being studied by General Electric's Advanced Electronics Center under an ARPA contract administered by Wright Air Development Division. Center is also seeking methods of detecting ICBMs from space vehicles, and in one case ground detection in all three ICBM stages—launch, out-of-atmosphere and re-entry. ARPA is the basic source of funds for this work.

▶ **Counter-Countermeasures**—Ways and means of reducing vulnerability of space navigation, guidance and data transmission systems to natural and man-made environments, including heat, shock, and radiation are to be studied by the Advanced Electronics Center under a contract obtained from WADD.

▶ **Optical Maser Getting Closer**—Operation of an optical Maser, expected to have wide applications for space communications and scientific studies, appears to be approaching. Scientists at Technical Research Group, Inc., have observed inversion in a krypton-mercury system and hope to measure amplication soon in a cesium system.

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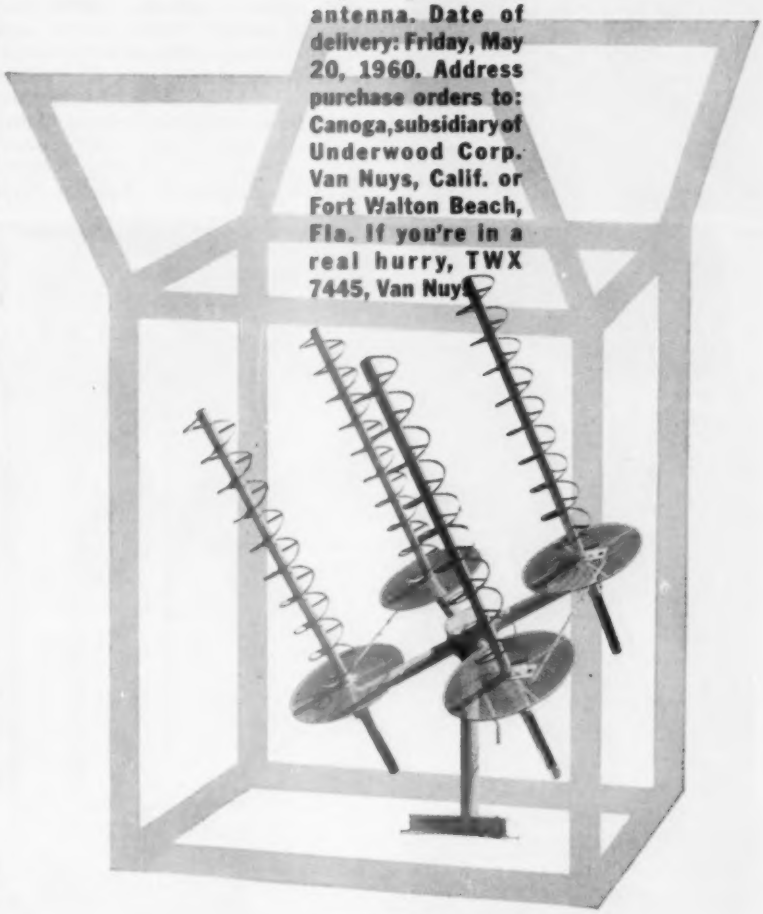

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Saturn Computer Has High Solution Speed

By Michael Yaffee

Huntsville, Ala.—High speed IBM 7090 digital computer is now in operation at the George C. Marshall Space Flight Center here (AW June 20, p. 79) and is expected to save "millions of dollars" through flight simulation in Project Saturn alone.

The fully transistorized computer, rented from the International Business Machines Corp. at a cost of $64,000 per month, is reportedly capable of adding 13,740,000 figures per minute and of making 27,480,000 logical decisions per minute. It has a 32,000 word memory, and data is available from storage in 2.18 microseconds.

Computers Keep Pace With Rocket Vehicles

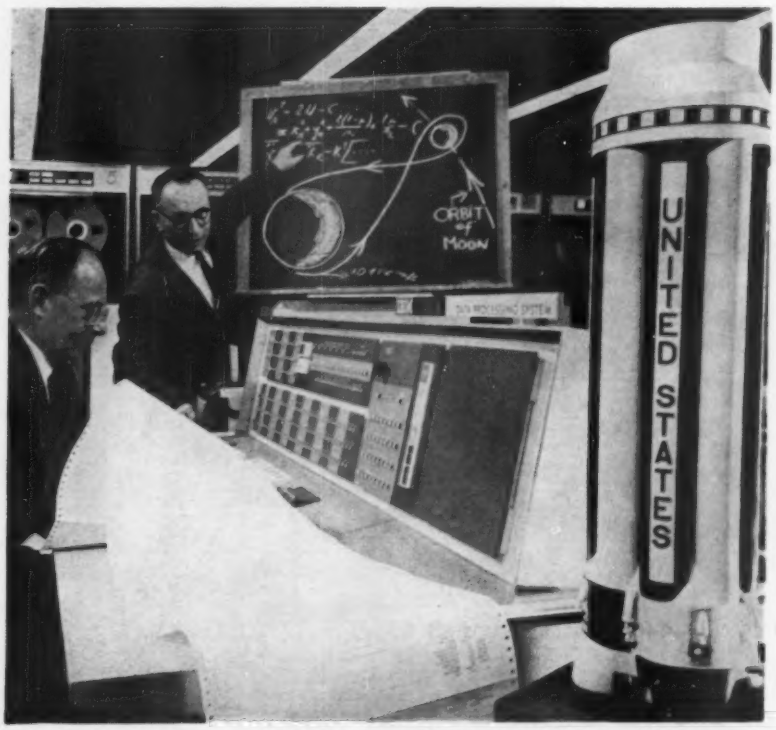
Date	Vehicle Program	Data Processing System
1951	Redstone	Card Programed Calculator (CPC). This digital computer could make 2,174 additions per minute.
1955	Jupiter C	IBM 650. A general purpose digital computer, the 650 could make 78,000 additions per minute.
1956	Jupiter IRBM	IBM 704 digital computer could make 2,496,000 additions or logical decisions per minute. Memory access time was 12 microseconds.
1959	Juno II	IBM 709 possessed the same decision making and addition capability as the 704, but had a larger core memory.
1960	Saturn	IBM 7090. A solid state digital computer, the 7090 can make 13,740,000 additions per min. or 27,480,000 logical decisions per minute. Data is available from storage in 2.18 microseconds.

Solution Speed

Input-output of the 7090 data processing system is significantly better than that of earlier systems and more important, says IBM, is its capability for performing computations simultaneously with input-out operations. Over-all problem-solving speed of 7090 is said to be almost 10 times that of the earlier IBM 704 and 709 data processing systems. (Sometime this year, the Atomic Energy Commission will put two new data systems into operation—the IBM STRETCH at Los Alamos and the Remington Rand LARC at Livermore—that will be faster than the 7090.)

Another significant advantage claimed for the 7090 over earlier data systems is its ability to monitor its own operation. Because of the computer's high internal speeds, computation personnel at Huntsville decided that it would be desirable to take as much computer management as possible out of human hands and turn it over to the machine itself. Toward this end, they developed SPOOK (Supervisory Program Over Other Kinds), which is said to be the first complete automatic operations monitor to be put in use. SPOOK consists of 50,000 instructions on a single reel of tape. Among other things, it enables the IBM 7090 to recognize whether incoming data should be used to diagnose its own performance, assemble a program or to run one of its data handling jobs. In the event of trouble during a test run, SPOOK will also prepare a "snapshot" of the situation in which the computer's stored information is printed out for analysis.

Marshall Space Flight Center plans to obtain a second 7090 computer in July. The two IBM 7090 units will replace two IBM 704 computers and one IBM 709 unit which were being run on a 24-hr. day, seven-days-a-week basis. The two new computers, IBM's Charles Benton, Jr., said, will be able to do the same amount of work in an 8 hr. period that it took the three previous computers 20 hr. to do. Moreover, it is claimed that the new computers will do this with a 25% saving in machine time costs and a corresponding decrease in personnel time.



DRS. HELMUT HOELZER AND RUDOLPH HOELKER of NASA's new Marshall Space Flight Center at Huntsville, Ala., study a moon orbit calculated in a few minutes with the aid of IBM 7090 data processing system. At right is a model of the Saturn booster.

Tasks Outlined

Initially, NASA scientists at the Marshall Space Flight Center will use the 7090 data processing system principally in the Project Saturn space vehicle program. Among the tasks the 7090 data system will be used for in this program are the following:

- **Analysis of vibration** and heat transfer caused by interaction of the engines.
- **Evaluation of telemetering data.**
- **Investigation of fuel slosh** in the booster's multiple tanks.
- **Analysis of thrust alignment** problems.
- **Determination of the optimum** method of redirecting fuel from engines that have failed to the remaining en-

gines at different stages of flight and under varying conditions of flameout.

• **Trajectory and flight determinations** and simulations. In the simulation of Saturn flights, scientists will store mathematical equations representing such factors as weather conditions, rotation and gravitation of the earth and moon in the IBM 7090. They then might feed booster design data into the computer for the computer to determine the trajectory the vehicle would take.

Along the same lines, when certain equipment changes are made in the Saturn, the 7090 will be used to simulate the flight of the revised vehicle. After studying the results, NASA scientists might then devise a new trajectory for the revised vehicle and simulate this on the computer. Evaluation of this second simulation may lead in turn to further changes and additional simulations.

Few Test Firings

Owing to high vehicle costs as well as to the availability of the new high speed data processing systems, there will be relatively few live Saturn test firings.

Present plans call for the firing of only 10 research and development vehicles. This compares with the development program for a relatively simple missile like the German V-2 where the lack of automatic digital computers necessitated approximately 1,000 test firings.

It would cost millions of dollars to stage an actual Saturn flight, according to Dr. Helmut Hoelzer, director of the Marshall Space Flight Center's Computation Division. On the other hand, a Saturn trajectory can be simulated on the 7090 in a few minutes at a cost of several hundred dollars, he pointed out, and from repeated flight simulation it will be possible to obtain much of the same desired information.

Saturn's size and complexity make it necessary to obtain eight to 10 times more static firing test data for computer analysis than in any previous space vehicle program. In early eight-engine static tests of the Saturn booster, for example, scientists collected information from 970 instrument channels attached to the booster. By comparison, static testing of the Redstone missile required only 100 instrument channels.

Future Evaluation

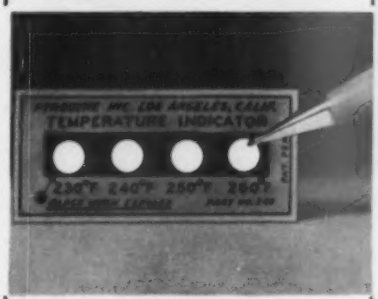
Later in the Saturn program, NASA said, far greater amounts of information will be collected from actual flight tests through telemetering and optical and electronic tracking. As an example of the value in this stage of the new, high speed data processing systems, Computation Division scientists referred to the fact that with the old Card Programed Calculator digital computers used in the Redstone program, it took up to six weeks to evaluate telemetering data. The Center's new 7090 computers, they said, will do the same job for the more complex Saturn in three to four days.

Modified versions of the IBM 7090 data processing system are being incorporated into the Ballistic Missile Early Warning System. Taking a look into the future, IBM's Benton foresees the day when powerful computers such as the 7090 will be linked in a communications network to solve problems such as weather prediction and ICBM defense.

Airborne Saturn Computer

A small digital computer designed for airborne use in Saturn space vehicles has now reached an advanced stage of development and is coming along well, according to Dr. Wernher von Braun, director of the George C. Marshall Space Flight Center. The computer will be used to solve guidance and control problems. There are now two designs for the computer which are being developed competitively by Librascope and International Business Machines.

TEMPERATURE INDICATING LABEL



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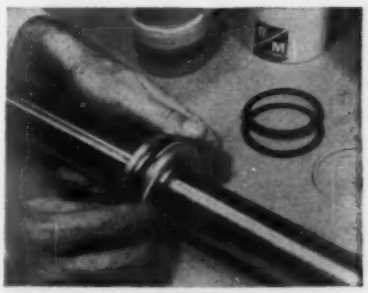

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All-Weather System Built Around N-156F

By Richard Sweeney

Los Angeles, Calif.—Northrop Corp. has combined its N-156F airframe with the Hughes Taran fire control and Nord missiles to form a weapon system, called Rapiere, having capability for all-weather air-to-air forward hemisphere attack as well as for blind delivery of its payload against ground targets.

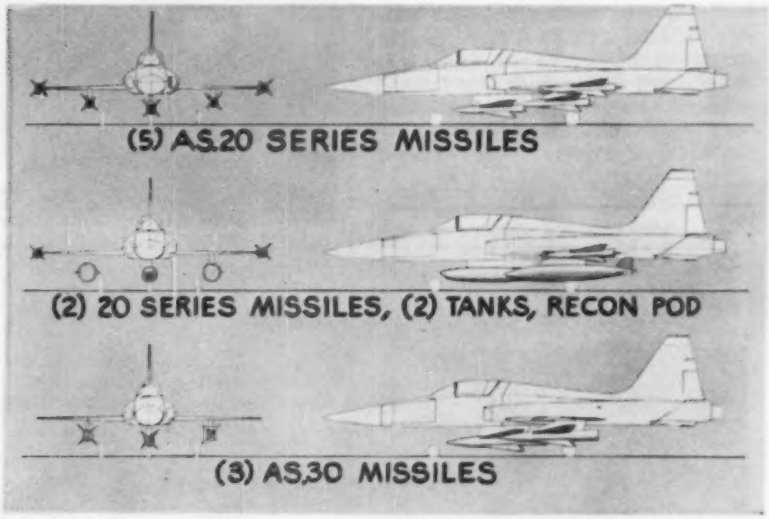
An additional design requirement was that all major elements of the weapon system be as close to production hardware as possible, to minimize time and cost necessary for integration of the airframe, missiles and fire control.

N-156F, being developed under Department of Defense auspices, will undergo flight testing with certain external stores, including separation tests at attack speeds. Stores will include wingtip Sidewinder missiles, a 2,000 lb. belly centerline store and 150 gal. wing pylon tanks. Tests will cover performance as well as stability and control with the stores.

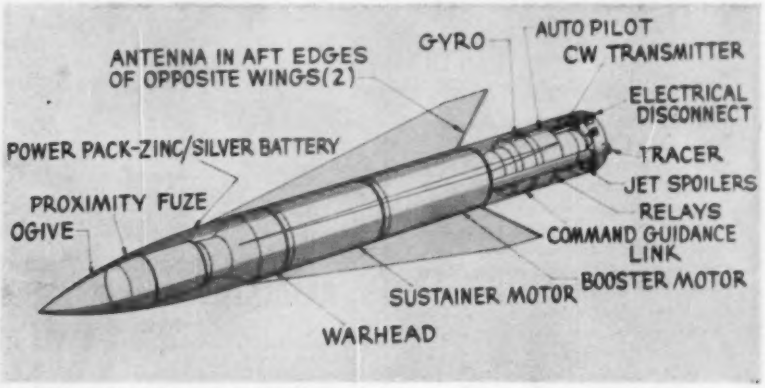
No testing is scheduled as yet for the N-156F in Rapiere configuration, and none is planned unless a purchaser is found for the system, Northrop indicates. Currently, Switzerland is considering the Rapiere, and Australia will have a team in the U. S. during the summer to investigate the weapon system thoroughly.

Missiles projected for use are developments of the Nord 5103 models, the AA.20 (air-to-air) and AS.20 (air-to-surface) weapons, which are pilot controlled by radio command via a small stick in the cockpit, with visual monitoring, like the U. S. Martin Bullpup.

Two expansions were made, to the AA.25 and AS.25 series (Nord models 5104) and the AS.30. Though the AA.25 was deemed adequate for the air-to-air mission, another increase was considered necessary to get desired effectiveness against ground targets, hence the AS.30 was developed. The AS.30 weighs 1,150 lb., can carry a 550 lb. warhead, or can be equipped with nuclear warhead.



N-156F MISSILE PLATFORM can mount missiles and stores in varied configurations.



NORD AA.25 solid-propellant, radar-controlled missile has four fingers located in the exhaust stream which act in diametrically opposed pairs for pitch and yaw control. Constant rotation for stabilization in flight is induced by fixed-fin offset angle.

Solid Propellant Missiles

All three series have solid propellant rocket motors, with four fingers located in the exhaust blast which act in diametrically opposed pairs for pitch and yaw control. All missiles have constant rotation induced by fixed fin offset angle, for stabilization in flight. Missiles have two gyros which change cognizance to match the constant roll rate, i.e. pitch gyro changes to yaw and back, while the yaw gyro changes to pitch and back.

Exhaust deflection fingers change cognizance with the gyros. Between 20 and 30 sec. guidance and control time is available during each missile flight.

For the later 25 and 30 series missiles, radar control was substituted for pilot visual monitoring and radio command, with inputs from the aircraft's radar passing through the plane's missile computer, then being sent to the missile as a computed corrective command signal. For this, two range gates are used on the aircraft radar, one for the missile, the other for the target. The computer determines the corrective signal to be sent the missile's autopilot from the differential readings of the two range gates as well as azimuth and elevation data.

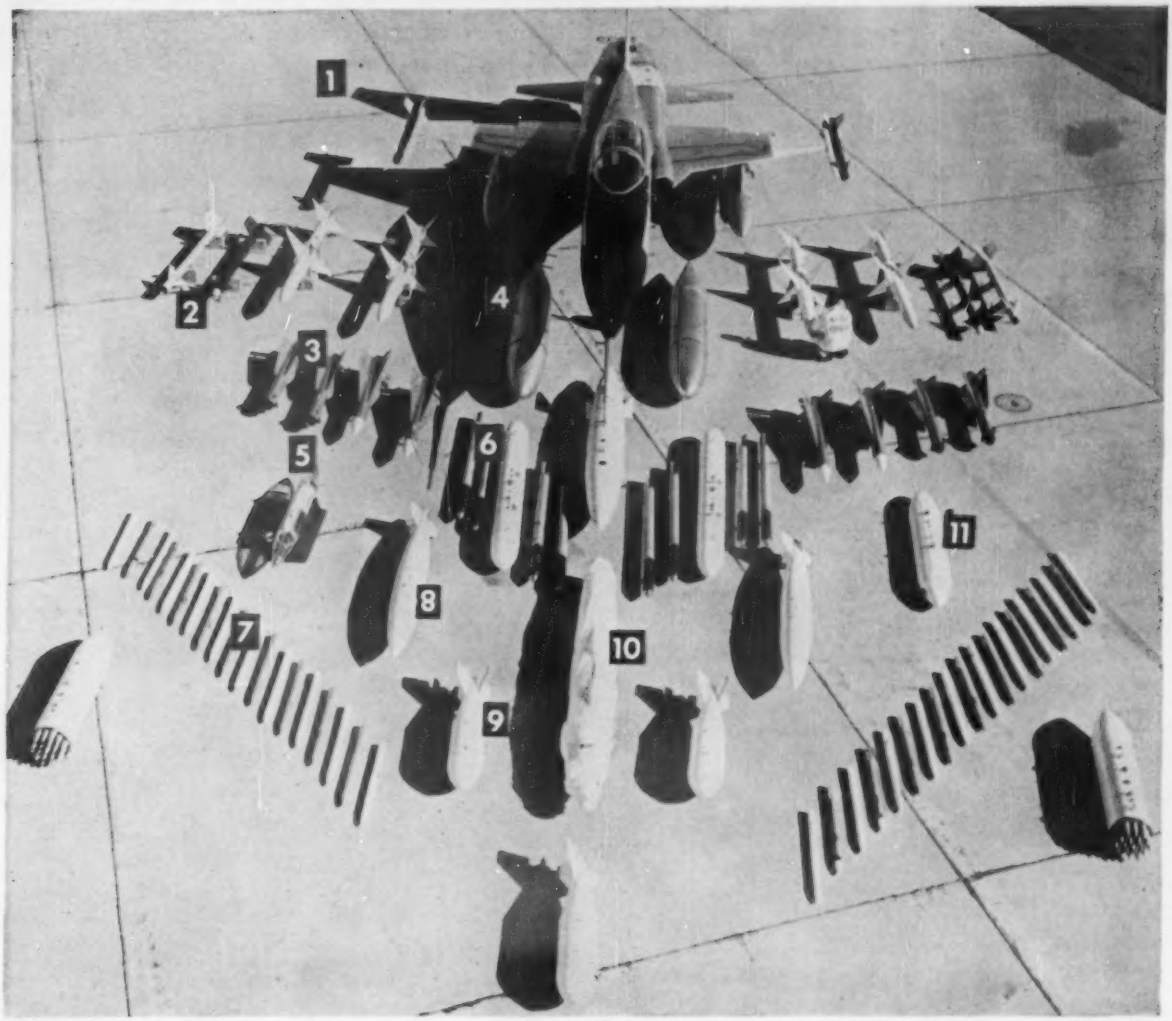
Missile Guidance

The missile is essentially a beam rider, but use of the computed corrective course commands steers the missile down the center of a precise track instead of leaving it free to digress within the cone angle of the radar beam.

Development of the Nord missiles, originally a French government project which was terminated in favor of the Matra, also has been supported by the U.S. Mutual Weapons Development Team, with half U. S. and half French funding. Development so far has carried through blind firings of 50 missiles in

NORTHROP N-156F flies with Sidewinder missiles on wingtips, 150-gal. tanks slung on pylons underneath the wings.

N-156F FLIGHT TEST program includes maneuvers with 2,000 lb. belly store which does not necessarily depict operational configuration.



VARIETY of weapon stores carried by the Northrop N-156F Freedom Fighter are shown in this display. They are (1) and (2) GAR-8-1A Sidewinders, with Sparrow IIIs at right (3) GAR-1-D and -3 Falcons (4) 750-lb. napalm bomb (5) 7.62 mm. Vulcan gun pack (6) LAV-10/A rocket launcher with four 5 in. Zunis (7) 2.75 in. FFARs, with Aero-7D rocket launcher in foreground (8) 1,000-lb. bomb (9) 500-lb. bomb (10) 2,000-lb. special weapon shape (11) Northrop Aero X-11A practice bomb and rocket launcher. Not shown are Nord missiles, Martin Bullpup and variety of larger Vulcan gun packs.

MISSION	WING TIPS	WING PYLONS	℄ PYLON	T.O. WT. POUNDS
LONG RANGE AIR-GROUND	(2) AS.20	(2) - 150 GAL TANKS	(1) AS.30	16,714
CLOSE SUPPT. AIR-GROUND	(2) AS.20	(2) 150 GAL TANKS OR (2) NAPALM	(1) AS.20	15,886
			(1) AS.30	16,714
	NONE	(2) AS.30	(1) AS.30	16,143
AIR-AIR PATROL	(2) AA.25	(2) - 150 GAL TANKS	(1) AA.25	15,829
	(2) SIDEWINDER			15,555
AIR-AIR INTERCEPT	NONE	NONE	(1) AA.25	12,806
RECON.	(2) AA.25	(2) - 150 GAL TANKS	(1) PHOTO POD	16,131
	(2) SIDEWINDER			15,857

CONFIGURATIONS for Northrop N-156F Rapiere weapon system are detailed above.

the AA.25 and AS.25 series, plus firings of 12 AS.30 missiles with the Taran fire control, using Mystere fighters.

Taran fire control makes use of many parts of the Hughes MG-13 equipment which is in service with the interceptor version of the McDonnell F-101B. For the Taran, parts of the system are being converted to solid state and being repackaged, while others are being just repackaged in "jeep cans" for the N-156F application. Some solid state conversions have been completed including the repackaging and some plain repackaging done. All solid state conversions have been breadboarded in Hughes' laboratory.

Provisions include totally automatic weapon launch, or pilot launch from the fire control system display, or manual weapon aim and launch. Pilot can override automatic launch if he desires.

With the Taran, the original plan was to have target acquisition and lock-on at about 60 deg. angle off. To ensure missile capture and control at this high angle off, additional equipment would have to be incorporated, increasing complexity and weight. Instead, capture angle may be reduced somewhat.

Inertial System

Rapiere navigation will be based on an inertial navigation unit, with stable platform and computer to be obtained by Northrop, possibly from Litton Industries or another source. The inertial system will furnish inputs to a moving-map horizontal situation display which has been developed by Hughes, and, while the display is similar to the moving map unit used in the Convair F-106 interceptor, it derives information from only the inertial system or pilot corrections, rather than from several inputs which are used in the Convair interceptor display.

Scale of the maps normally is such that an area the size of the United States can be stored on six slides. Transfer from one slide to another is automatic. Should the pilot want to study the target slide while en route, there are selective switching provisions. While the proper map is out of view, a memory unit in the inertial system keeps track of position changes and when the proper map comes back into place the correct position appears automatically. Scaling is provided for such things as target area maps or other special map requirements, where larger views may be desired.

Taran radar scope is located adjacent to the horizontal situation display, so that in the final stages of a blind attack, map outlines can be compared with radar outlines for a target cross check. The horizontal situation display in the Rapiere is mounted on the vertical panel rather than between the pilot's legs as in the F-106.

USAF Scored on Plan To Buy Oxygen Plants

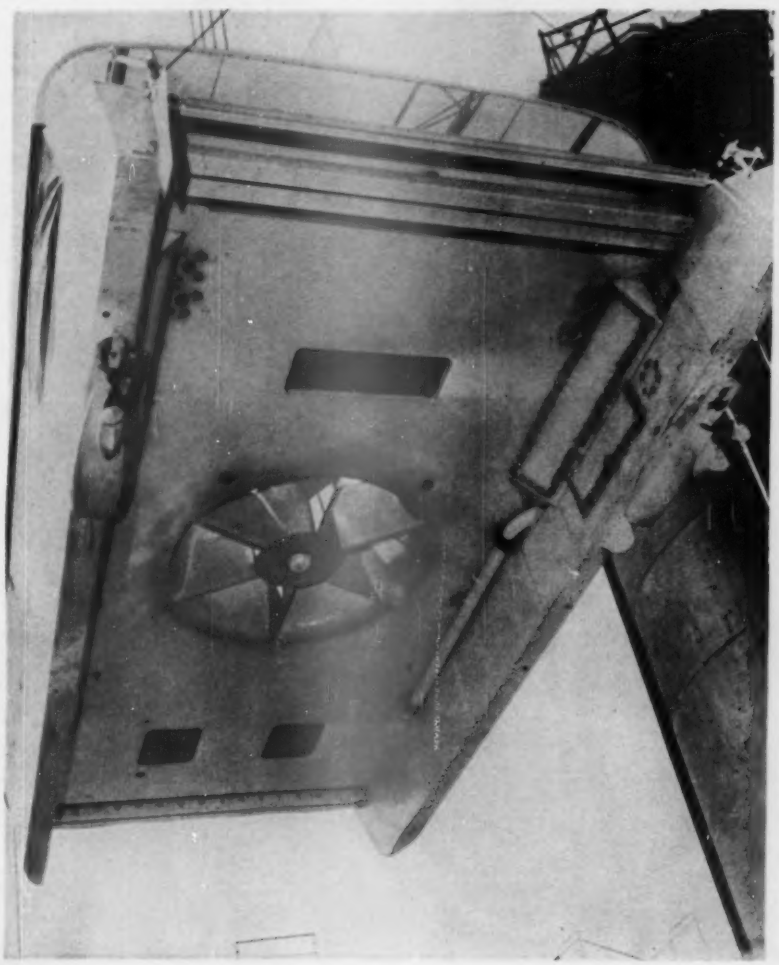
Washington—Senate Small Business Subcommittee has charged Air Force with "unwarranted competition with private business" and asked USAF to reconsider its plan for purchase of 64 liquid oxygen producing plants.

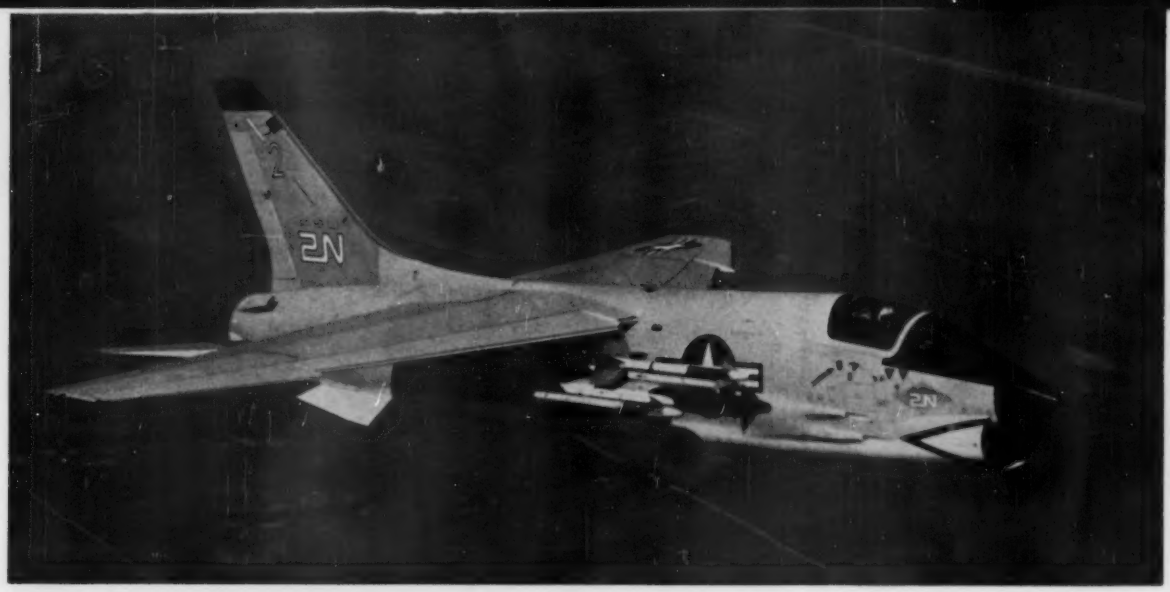
Air Force plans call for purchase of a total of 70 plants for on-base manufacture of a large portion of the oxygen needed by pilots.

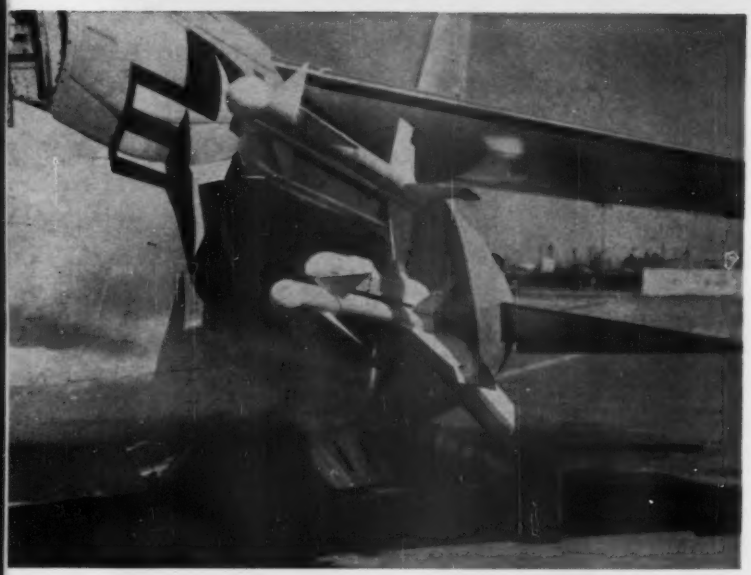
The subcommittee, headed by Sen. Alan Bible (D.-Nev.), said that at hearings USAF did not "satisfactorily support its contention" that the storage of liquid oxygen is "not acceptable or practicable."

Navy to Test Hughes Air-Cushion Water Craft

Hydrostreak air-cushion vehicle developed by Hughes Tool Co. has been turned over to Navy for testing. The 21-ft.-long craft rides on a cushion of air held under the hull by fore and aft water walls formed by water pumped through slit-like nozzles which extend horizontally across bow and stern. Fan in center of hull pumps air beneath the water craft. Propellers are mounted aft of water scoops. Note twin rudders.

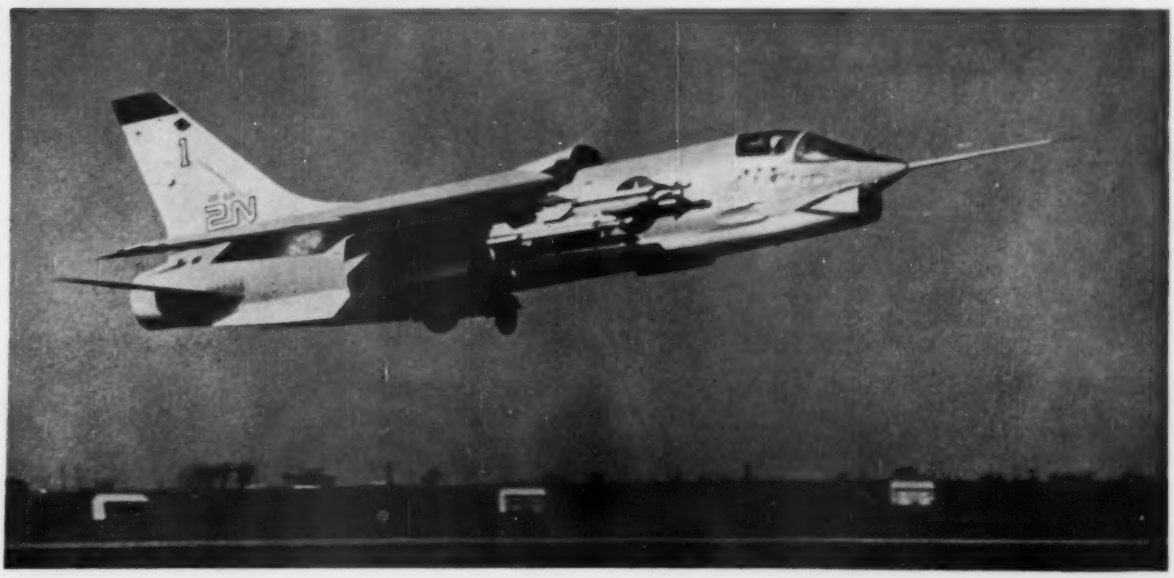




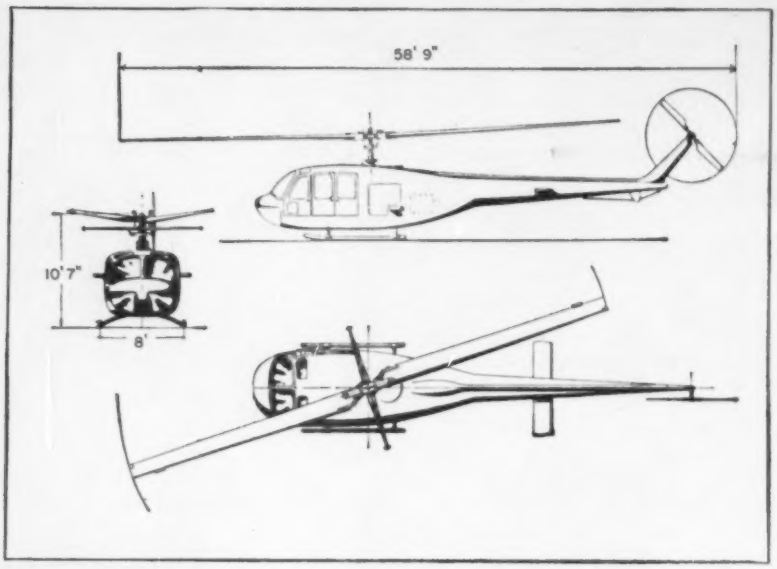


Chance Vought F8U-2N Armed With 4 Sidewinders

Chance Vought Aircraft is producing the F8U-2N Crusader fighter (AW Feb. 2, 1959, p. 37) for Navy under contracts totaling about $100 million. Four Sidewinders are attached, two on each side, to a magensium T-shaped bracket. The fighter also is armed with a 20-mm. cannon. Chance Vought autopilot permits the pilot to hold altitude, heading, or pitch and roll attitude by pushing a button on the control stick. A change in heading or bank angle can be made by turning a dial. The F8U-2N is equipped with a Martin-Baker ejection seat which permits escape at ground level. The aircraft is scheduled to begin carrier qualifications tests this summer.



Chance Vought F8U-2N with four Sidewinder missiles (two on each side) is photographed with a telephoto lens from airport control tower as the Crusader passes by at 430 kt. Powerplant is a Pratt & Whitney J57-P-20 rated at 18,000 lb. thrust maximum at sea level.



AGUSTA-BELL 102 uses Bell rotating components and Pratt & Whitney R1340 engine.

Agusta-Bell 102 Enters Production

Agusta-Bell helicopter, now in production in the Agusta company's Cascina Costa facility in northern Italy, will offer a variety of passenger/cargo configurations for maximum versatility.

The civil helicopter, which first flew in February, 1959, is the first Italian helicopter to be certificated under U. S. Civil Air Regulations Part 6 requirements.

The single-rotor vehicle utilizes Bell HU-1A rotating components and a Canadian Pratt & Whitney R1340 engine developing 600 hp. maximum.

Conventional in appearance, the skid-mounted 102 employs a two-bladed 47-ft. rotor and a 7 ft. 8 in. two-bladed tail rotor. Gross weight of the helicopter is 6,280 lb. Empty weight is 3,960 lb.

Seating Variations

The various internal configurations of the Agusta-Bell are designed to take maximum advantage of the 2,310 lb. useful load of the aircraft.

Operating on a typical helicopter airline route, Agusta says the 102 can carry nine passengers plus, the pilot and 250 lb. of baggage or equipment. Seating in this high-density configuration would be two seats forward for the pilot and one passenger, followed by a row of three seats and another row of five.

Maximum range for the helicopter in this configuration is 62 mi. (100 km.) with 10% fuel reserves.

Stage lengths of 220 mi. (350 km.) permit a seven-passenger capability (1,230 lb.) plus pilot and 260 lb. of baggage.

This seating arrangement is achieved by removing two seats from the second row of the high density configuration. This leaves a two, one, five seating arrangement for the 350 mi. stage length.

Medical evacuation, another mission suggested by Agusta, may be accomplished with four litters (two stacks of two) behind the two forward seats for pilot and attendant. Available fuel load in the fully loaded medical evacuation version is 980 lb. Agusta says the R1340 engine will maintain takeoff power at altitudes to 6,500 ft. Mountain transport missions may be performed at altitudes of 11,500 ft. for periods up to one hour, according to the company.

Cargo Capacity

The helicopter is equipped to carry an external cargo for use in construction operations. The maximum cargo load at sea level is 1,940 lb. In order to carry this payload, the Agusta-Bell 102 must carry one pilot and 100 lb. of fuel, limiting its range to 31 mi. The external cargo load is suspended in a sling beneath the helicopter.

Maximum speed of the Agusta-Bell is 121 mph. Cruise speed for best range is 100 mph. at 2,000 ft. altitude. Service ceiling of the helicopter is listed at 14,000 ft. and it will hover in ground effect at 9,500 ft. Maximum endurance is 3 hr. 20 min.

The helicopter is 58 ft. 9 in. long, 8 ft. wide and 10 ft. 7 in. high. Rotor diameter is 47 ft.

Umbaugh-18 Gets New V-Tail

Latest Umbaugh-18 autogyros feature new V-tail which company says will add to stability and, with identical surfaces, facilitate production. Of five production models being manufactured at the Hagerstown, Md., plant of Fairchild Engine & Airplane Corp., under contract to Umbaugh (AW May 9, p. 33), two already have been rolled out. Preceding these were prototypes which had flown in varied tail configurations: Seabee-type single vertical fin and stabilizer, and Bellanca-type tail with three vertical stabilizers. Aircraft is not yet certificated, though Umbaugh claims it will be in full production this winter.

Coating Cuts Oxidation During Metal Working

Spray precoating method of sharply reducing oxidation and material losses during hot-forming, stress relieving and heat treating has been developed by Chance Vought Aircraft's Aeronautics Division.

Process, applicable to any metal to which copper or aluminum is non-alloyable, including "exotic" materials such as beryllium, molybdenum, rhenium, tantalum, tungsten, vanadium and zirconium as well as nickel alloys, keeps material loss to between .0001 and .005 in. during treatment compared with approximately .002 and .012 in. for conventional methods.

Copper or aluminum coating sprayed onto material before treating provides a protective oxide coating which also acts as a lubricant for subsequent forming, stops oxidation of the material, and yet is easily removable after treatment.

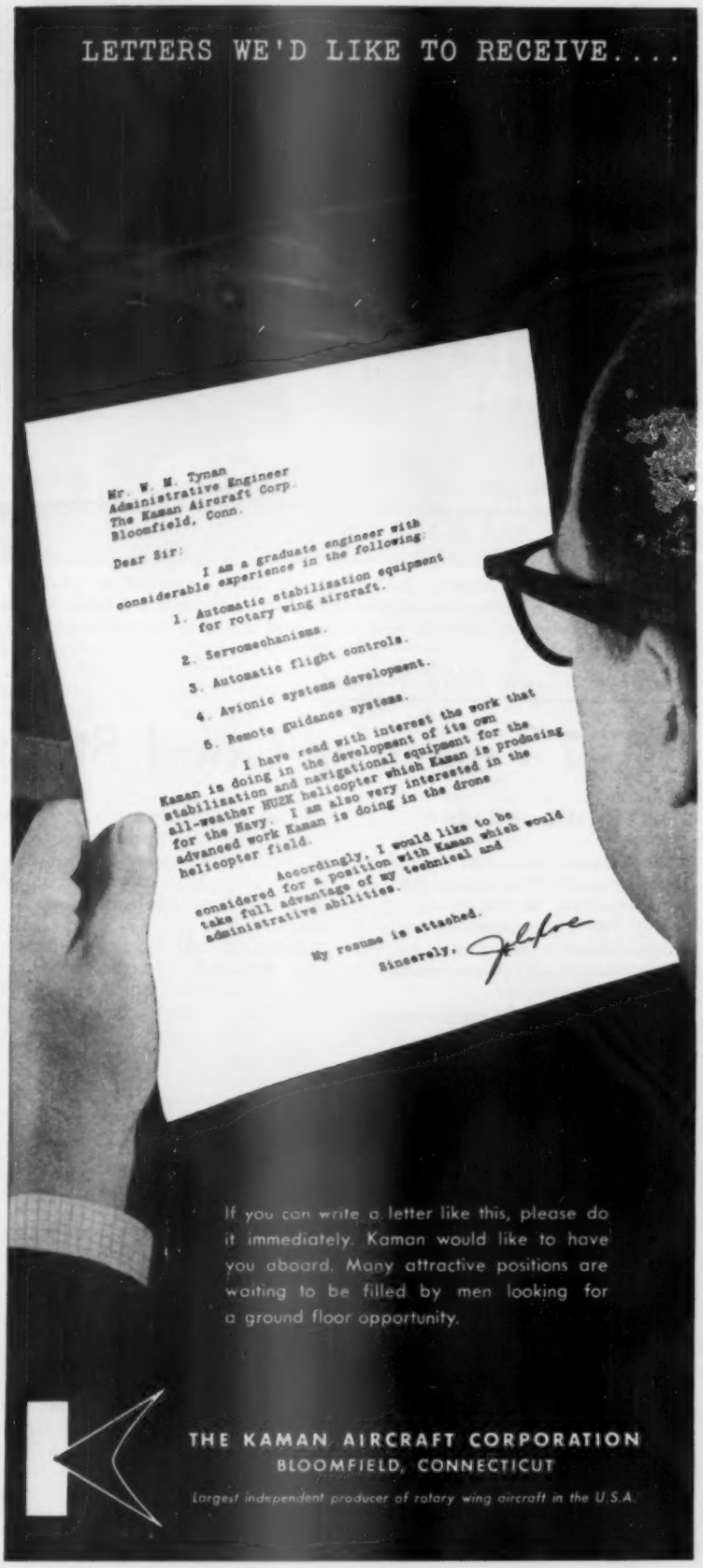
The solution may comprise an aluminum pigment paste powder or flakes dissolved in lacquer or thinner, or it may be aluminum or copper oxide. The organic binder is burned out during metal treatment.

The process also has been found useful in protecting steel and stainless steel brazing envelopes and boxes from oxidation at temperatures up to 2,000F. Previously the retorts had to be cleaned of heat scale by sand blasting and vapor honing after each brazing cycle. The precoat method makes it possible to make retorts of much cheaper material than stainless steel. As the coating wears off, it can be removed by a sodium hydroxide method so that it can be recoated.

PRODUCTION BRIEFING

Kellett Aircraft Corp., Willow Grove, Pa., will develop a helicopter water ditching trainer for the Marine Corps. The trainer will be installed in a tank at Camp Pendleton, Calif. Kellett's contract, let by the Navy Training Device Center, Port Washington, N. Y., will be over $150,000.

Army Corps of Engineers has awarded a $24.4 million contract for construction of 12 Atlas ICBM launching complexes near Plattsburgh, N. Y. Contract was won by a joint venture construction group sponsored by Raymond International, Inc., whose partners in the project include Henry J. Kaiser Co., Oakland, Calif.; Macco Corp., Paramount, Calif., and the Puget Sound Bridge and Dry Dock Corp., Seattle, Wash.


LETTERS WE'D LIKE TO RECEIVE....
Mr. W. M. Tynan
Administrative Engineer
The Kaman Aircraft Corp.
Bloomfield, Conn.
Dear Sir:
I am a graduate engineer with considerable experience in the following:
1. Automatic stabilization equipment for rotary wing aircraft.
2. Servomechanisms.
3. Automatic flight controls.
4. Avionic systems development.
5. Remote guidance systems.
I have read with interest the work that Kaman is doing in the development of its own stabilization and navigational equipment for the all-weather HU2K helicopter which Kaman is producing for the Navy. I am also very interested in the advanced work Kaman is doing in the drone helicopter field.
Accordingly, I would like to be considered for a position with Kaman which would take full advantage of my technical and administrative abilities.
My resume is attached.
Sincerely,
If you can write a letter like this, please do it immediately. Kaman would like to have you aboard. Many attractive positions are waiting to be filled by men looking for a ground floor opportunity.
THE KAMAN AIRCRAFT CORPORATION
BLOOMFIELD, CONNECTICUT
Largest independent producer of rotary wing aircraft in the U.S.A.

BUBBLE CANOPY of Andreasson BA-7 affords easy access to cockpit for pilot and passenger, and provides good visibility. Present directional control is oversensitive because of the large rudder area in relation to vertical fin area, so a swept vertical fin and rudder modification is planned. Antenna mast in front of canopy is for battery-operated receiver.

Aviation Week Pilot Report:

BA-7 Features Good Stability, Control

By William S. Reed

San Diego—Commercial interest has developed in the Andreasson BA-7, an example of one of the privately built aircraft for which increasing numbers of applications are being made for Federal Aviation Agency Experimental Airworthiness Certificates.

Unique design and simple fabrication techniques, coupled with emphasis on weight reduction, enable this light sport-business aircraft to coax a 140-mph. cruise speed out of a 75 hp. engine.

Combined with good performance, the small, two-place BA-7 demonstrated unusually good stability and control about all three axes in all speed regimes during a flight by this AVIATION WEEK pilot.

Built as a spare time venture by Convair control systems group leader Bjorn Andreasson, the aircraft represents years of idea formulation, 1,500 hr. of labor, but only about $1,000 in materials, including a used engine. All-around appeal of the design has resulted in considerable commercial interest in the BA-7 and arrangements virtually are completed for producing the aircraft in Sweden by "one the country's leading industry groups," Andreasson claims. Projected retail price in the U. S. is about $5,000.

Design of the BA-7, seventh in the line of Andreasson's efforts, is aimed at providing these advantages:

- **High cruise speed,** realized by exceptionally light empty weight—584 lb., and clean construction, including flush riveting.
- **Good visibility** for pilot and passenger, afforded by a bubble canopy above the swept-forward, shoulder-high wing.
- **Simplified construction** featuring a monocoque stressed skin fuselage with only three bulkheads and a single-spar wing built around a standard 2024-T3 aluminum extension.

AVIATION WEEK's evaluation of the BA-7 indicates that Andreasson has accomplished his aim, has produced an aircraft that is safe, easy to fly and yet not lacking in the handling qualities that make it enjoyable to fly.

The BA-7 is being certificated in Sweden and since reciprocal agreements exist with the U. S., certification will be gained here. Load analyses have been completed and the stress analysis now is being accomplished.

Although designed to be fully aerobatic and stressed for +6 and −3 g, the aircraft will be certificated under the utility category, Andreasson claims. Present experimental category allows the aircraft to be modified, such as installation of a new vertical fin and rudder, but it cannot be flown for compensation.

Ground handling presents no problem since the aircraft's light weight permits it to be wheeled about with ease by one man. Although a tow bar is provided, ground movement is easily accomplished by one man pulling or pushing the aircraft.

Entrance is gained through the clam shell bubble canopy and the controls are conveniently grouped for easy access. Although the present aircraft has no electrical system or starter, production version will be offered with these items as optional equipment.

Taxiing is accomplished with rudder-actuated nosewheel-steering, and hy-

BA-7 Specifications

Gross weight	1,200 lb.
Empty weight	584 lb.
Useful load	616 lb.
Wing span	23 ft.
Length	18 ft.
Height	8 ft.
Wing area	92 sq. ft.
Wing load (max. gross)	13 psf.
Power loading	16 lb./hp. (12 lb./hp.)*
Engine	Continental A75—75 hp. Continental O-200—100 hp.
Fuel capacity	20 gal.
Range	600 mi.

* With the Continental O-200

draulic brakes are fitted to both main landing gear. Brakes are applied with a hand-operated lever on a central pedestal; they are not individually operable.

Unusual visibility is afforded through the plastic canopy by the pilot's position above and ahead of the wing, permitting a thorough check of uncontrolled traffic prior to taking the runway for takeoff.

Precise directional control is easily maintained on takeoff and liftoff is accomplished at approximately 60 mph. indicated airspeed with little or no back pressure necessary on the control stick. Takeoff run with one person aboard approximates only 500 ft.

Initial rate of climb is about 500 fpm. despite the handicap in low speed performance caused by a cruising propeller. The unusual visibility afforded by being above and ahead of the wing again is noticeable in turning out of traffic.

The center-located control stick, which caused some minor apprehension prior to takeoff, proved to be not in the least awkward as previously anticipated. Over-the-nose visibility throughout the climb at 80 mph. is good.

The BA-7 exhibits positive speed stability throughout acceleration from climb to cruising speed in level flight, and requires a minimum of trim as speed increases. Longitudinal control is accomplished through an all-flying tail with an anti-servo tab to provide trim and a force feedback through the nonlinear control rod for pilot feel. The stick force per g gradient is positive but at the same time neither too light nor too heavy.

Aileron Response

Aileron response throughout the speed regime is very good and, like the elevator control, has very little friction and low breakout force, a feature generally uncommon in light aircraft.

Directional control is somewhat critical because of the large rudder area in relation to vertical stabilizer area. The over-sensitivity of rudder control will be alleviated soon with installation of a swept vertical fin and rudder already designed and now being fabricated.

Top speed at 3,000 ft. mean sea level, with temperature about 50F and at 2,600 rpm., is 143 mph. IAS, which compares favorably with Andreasson's guarantee of 150 maximum true airspeed.

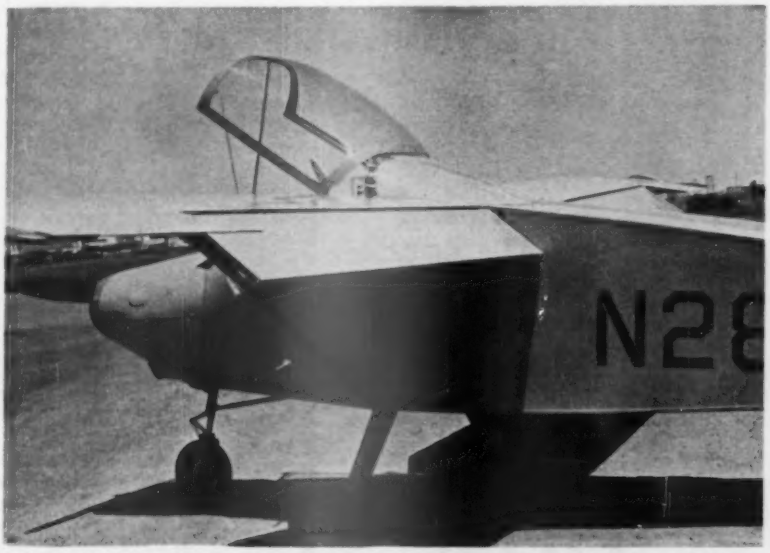
Restricted elevator movement prevents the aircraft from being stalled and results in a minimum attainable airspeed of 60 mph. IAS. Rudder and aileron control at minimum speed is excellent, both power-on and power-off, and turns can be executed comfortably without stalling. The aircraft also has been demonstrated to be completely spin-proof, Andreasson asserts.

CONTROL STICK is mounted on a center channel which also supports the nose gear and engine firewall. Hand-operated brake is forward of the stick; elevator trim is out of view behind the stick. Throttle, of push-pull type, is at top center.

Any attempt to stall or spin is thwarted by the inherent stability of the aircraft. This AVIATION WEEK pilot assumed a very high, nose-up attitude from cruising speed by pulling up sharply and cutting the power back to idle. As the airspeed bled off rapidly, the nose gently lowered and the aircraft stabilized in a 60-mph. glide, with no tendency to stall.

Landing is accomplished out of a glide of approximately 75-80 mph. IAS. Although flaps and trim both must be actuated with the right hand while in the left seat, the absence of trim change with power or speed change or while lowering flaps does not render it unsafe to leave the stick free. If preferred, the control stick easily can be held with the left hand while the right hand is used for trim or flap operation.

Very little tendency to float is apparent during the flareout for landing because of the restricted elevator power available and because the airfoil exhibits laminar flow characteristics. A low flareout, therefore, is recommended rather than the conventional technique with light aircraft. The rugged, tapered steel rod which forms the main landing gear is sufficiently strong to withstand the somewhat hard landing which would be caused by flaring out too high,



SHORT-SPAN AILERONS are extremely effective because they are of the sealed type. Note external longerons on the fuselage box corners aft of the wing.

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7W

Hiller 12E Helicopter Sprays Cotton Crop

Hiller 12E helicopter, owned by WhirlWide Helicopters, Inc., Fresno, Calif., sprays cotton in the San Joaquin valley, using a magnesium chlorate solution. Company claims Hiller develops 2 million cu. ft. of downwash per minute, allowing more efficient application of spray.

as was experienced by this pilot on the first landing attempt.

The aircraft touches down at about 60 mph. IAS, rolling out about 450 ft. with moderate braking.

Fuselage is a sheet metal box with external longerons, rectangular in cross-section from the firewall aft. One built-up bulkhead serves as the wing carry-through structure, as landing gear and fuel tank support, and seats-attach point. At three points aft of the main bulkhead, other bulkheads are formed from the addition of internal angle-stiffeners with gussets at each of the four corners.

Wing is built around a single spar of standard extrusion size with flush-riveted .040 magnesium skin. Production version will feature a flush-riveted 032 aluminum alloy skin.

Ailerons are cable-operated and sealed to prevent aerodynamic losses. A simple flap is used. Wing has a single bracing-strut on each side and features an NACA 23008.5 section. Aspect ratio is 6, with chord of 4 ft. Dihedral is 1 deg., incidence is 2 deg.

The wing is swept forward 3 deg. to permit the passenger to be carried practically on the CG. Wing thickness is narrowed at the root by removing a portion of the spar web, bending the caps, and riveting stiffeners to the web. Wing attach points also are riveted to the web. Reducing thickness at the root gives better pilot visibility, and also reduces drag in the root area.

Horizontal tail is an all-metal, cantilever stabilator supported by a large ball bearing utilizing a non-linear mechanism to decrease sensitivity around neutral.

Stabilator span is 7 ft. 6 in.

Variable Pitch Propeller

Present 75-hp. powerplant soon will be replaced by a 100-hp. unit and Andreasson is working on a variable pitch propeller of his own design which automatically will change pitch by sensing disk loading. New propeller should give better climb performance while still permitting high cruising speed.

Production version will incorporate two glass fiber, contoured bucket seats affording considerably greater comfort. Bottom of the seats will have a large area of plastic foam to absorb shock in a crash landing.

Rudolph Abilin, a former Swedish test pilot now attached to a Swedish industry group, has made a number of evaluation flights in the BA-7. Plans presently call for the BA-7 to be produced in Sweden for the European market in a slightly modified, improved version. First production aircraft should be available in about one year. Models for the U. S. market probably will be constructed in Sweden and shipped here, minus the engine.

Loran Receiver

D-X Navigator, new lightweight Loran receiver, has been developed for business aircraft by Electro-Nuclear Apparatus Co., Baltimore, Md. Unit weighs 23 lb., requires 90 watts and is available in 115 v. a. c. or 12 v. d. c. models.

Rumanian GP-2 Glider Passes Flight Tests

Rumanian glider, the two-place all wood GP-2, has successfully passed government trials, according to Soviet reports. Featuring a swept-forward wing, the GP-2 span is 52.5 ft. and is 26.2 ft. long. Wing area is 196 sq. ft. Empty weight is 726 lb. and gross weight is 1,124 lb. Best glide rate is reported to be 1:26 and minimum sinking speed as 2.46 fps.

The Richmond Arsenal was producing thousands of rockets for the Confederacy and experimentations on their deadly missiles were still underway as late as 1865.

Today, as a vital part of one of the world's largest electronics companies, Raytheon's Missile Systems Division is making significant contributions to the art of missilery. The exciting new Pin Cushion Project for selective missile identification, the constantly advancing Navy's air-to-air SPARROW III and Army's HAWK are examples of their outstanding creative work.

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Please apply to Mr. W. F. O'Melia, Employment Manager, Bedford Laboratory, Missile Systems Division, Raytheon Company, Bedford, Massachusetts.

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RAYTHEON MISSILE SYSTEMS DIVISION

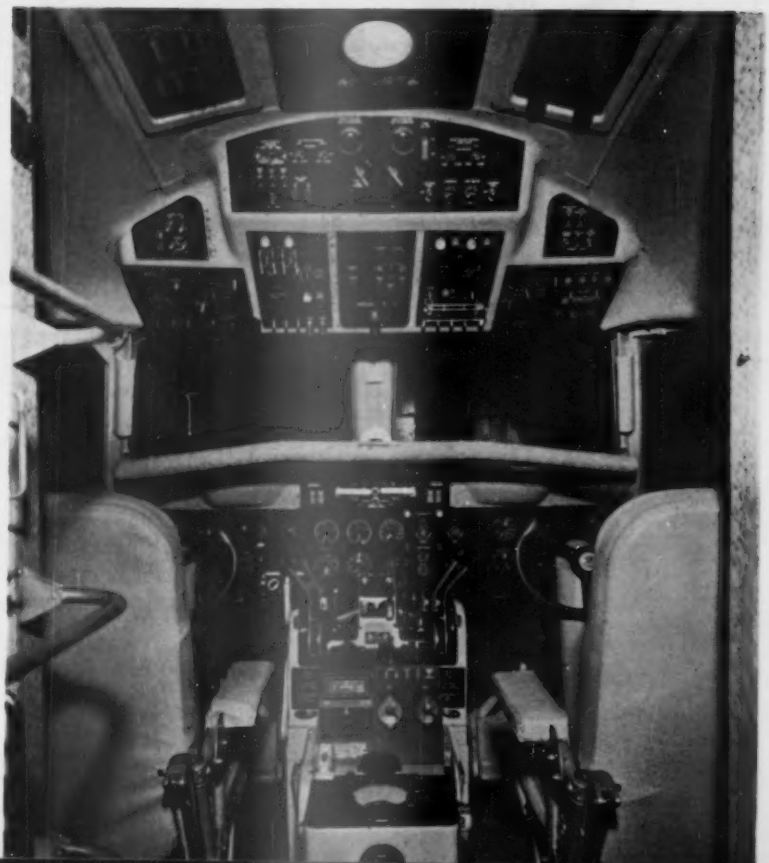
... creates a climate for talent.

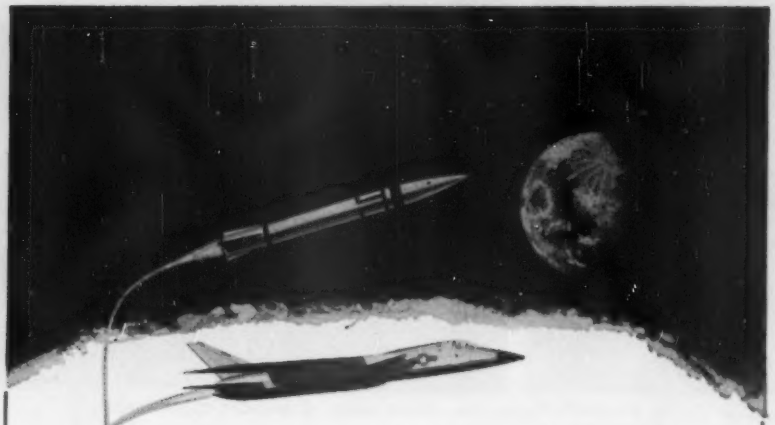
Main cabin of Convair converted for the Coca-Cola Co. by Remmert-Werner, Inc., shows variety of executive appointments.

Office bulkhead may be removed for full length open cabin. Private office at right features jack-knifing desk.

Convair Converted For Executive Use

Custom cockpit of converted Convair features Bendix X-band radar, Sperry SP20 autopilot, dual Collins 51R omnis with Collins 51V glideslopes, dual Bendix RMI and Omni Mag, Collins 17L-51X VHF, Aircraft Radio Corp. 210 standby VHF, dual Bendix ADF with iron core loops, Collins 51X marker, Remmert-Werner isolation amplifier, custom radio and instrument panels, and special racks for maintenance books and Jeppeson manuals and charts. The Convair 440 is powered by Pratt & Whitney R2800-CB16 engines at 2,400 hp. Conversion was made for the Coca-Cola Co., Atlanta, Ga., which will use the aircraft for transportation of executives, sales and technical personnel. In its converted configuration, the Convair 440 will accommodate 17 passengers. Equipment includes tables, swivel chairs, desks, work tables, electrical facilities for typewriters, dictating and other office machines, galley, lavatory and other appointments.





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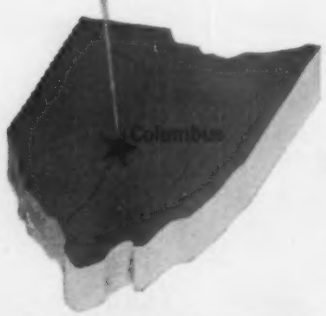
Please write to: H. Keever, Engineering Personnel Manager, Box AW272, North American Aviation, Inc., Columbus, Ohio.



THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Home of the T2J Buckeye and the A3J Vigilante

U. S. Pilots Invited To Fly Communaute

United States pilots and businessmen are being invited to Paris this fall to fly and evaluate the six to eight passenger, French-built, twin-turboprop Dassault Communaute MD-415 prototype. Aim is to promote enough American interest —and orders—to warrant production of the 335-mph. business transport.

The invitation does not cover the cost of fare, but includes five-day accommodations by Generale Aeronautique Marcel Dassault. A trip via chartered airliner from Chicago and New York on Sept. 1, with a return on Sept. 7, is being arranged by Don Payton, business aircraft consultant of Westchester, Ill.

Payton, who would market the Communaute here, hopes to interest up to 70 persons to make the trip at a minimum round-trip fare cost of $300 each.

The MD-415, with equipment, would sell at an estimated $400,000. Price includes radar, dual communication and navigation radio, complete deicing equipment, safety systems and standard six-passenger executive interior.

Cost would be based on 100 orders, though the "airplane would move with only 10 orders in hand," Payton told AVIATION WEEK. He also stated the possibility that the airplane could be produced either by Sud Aviation in France or under license in the United States, should orders warrant. The single prototype has been evaluated by the French military services (AW Apr. 25, p. 34) with both an oval and circular fuselage cross-section; the latter probably would be fitted to a commercial version.

During the five-day stay in France, pilots will receive ground schooling on the pressurized aircraft's airframe and propeller-engine combination, plus a tour of production facilities as well as an opportunity to fly the prototype.

The Communaute has an empty weight of 8,500 lb. Gross weight is 15,600 lb. Over-all length is 50 ft. 6 in., wing span is 54 ft. 10 in. Cabin height is 5 ft. 6 in.; cabin length is 21 ft. 8 in. Power is supplied by two Turbomeca Bastan turboprops of 1,000 ehp. each.

With maximum cruise of 335 mph., two crew and six passengers, range of the MD-415 is specified as 1,800 mi. Single-engine service ceiling is 16,000 ft.; twin-engine, 36,000 ft. Stall speed at 13,000 lb. is 64 kt. Rate of climb at sea level is 2,800 fpm.

Along with Payton, the United States-French transportation committee consists of Robert L. Hansen, chief pilot, Krochler Manufacturing Co.; Charles Ridings, transportation manager, Barber-Colman Co., and Robert H. Vinson, chief pilot, International Minerals and Chemicals Corp.

WHO'S WHERE

(Continued from page 23)

Changes

R. S. Saye, chief project engineer for Thor systems, Douglas Aircraft Co., Inc., Santa Monica, Calif., succeeding **H. M. Thomas,** now Saturn program manager. Other Thor project appointments: **D. E. Brimley,** assistant chief project engineer; **N. J. Heckman,** project engineer-field station testing; **W. H. Hess,** project engineer-missile, ground support equipment and contract requirements. Also: **Horace G. Irwin,** space systems project engineer for Douglas' Delta and Thor-Able space vehicle programs, succeeding **Ted J. Gordon,** now project engineer for the Saturn S-4 second stage.

Kenneth B. Haugen, director-Flight Operations Department, Northwest Orient Airlines.

Leopold R. Michel, product manager—automatic control group, Laboratory for Electronics, Inc., Boston, Mass.

Oleg C. Enikeieff, director of the Marquardt Corp.'s newly-established Special Projects Laboratory, Rockville, Md.

Leo Tobacman, chief engineer, Airborne Mechanisms Division, Randolph Mfg. Co., East Cleveland, Ohio.

William H. Conway and **Arnold C. Knudsen** have joined the technical staff of Space Electronics Corp., Glendale, Calif.

John W. Dozier, chief engineer, Aircraft Equipment Testing Co., Inc., Baltimore.

Donald L. Dewing, director of management control, Solid Rocket Plant, Aerojet-General Corp., Sacramento, Calif.

Murray A. Schwartz, head of the high temperature materials program, Research Division of United Technology Corp., Sunnyvale, Calif., a subsidiary of United Aircraft Corp.

Paul S. Dove has joined the Washington, D. C., staff of Stromberg-Carlson Division of General Dynamics Corp.

Andrew W. Walters, head of the Corona, Calif., division of Geo Astro Corp.

A. M. Okun, manager of product assurance, Semiconductor and Materials Division of RCA, Somerville, N. J.

George H. Vottler, regional sales manager, Seaboard & Western Airlines, Inc.

Joshua G. Marash, East Coast regional manager, El Al Israel Airlines, New York.

Earl S. Goodwin, director of corporate purchases, Westinghouse Electric Corp., Pittsburgh, Pa.

Edward M. Hayes, superintendent of engineering for new aircraft, United Air Lines, San Francisco, Calif.

J. Gordon Vaeth, manager of the newly established Washington, D. C., office of Reflectone Electronics, Inc.

Z. R. S. Ratajski, chief of research and advanced development, Precision Components Division, Kearfott Division of General Precision, Inc., Little Falls, N. J.

Norman E. Eggers, manager of commercial and military engine and propeller sales, Aircraft Engines Operations of Allison Division of General Motors, Indianapolis, Ind., and **Donald D. Davis,** manager of military and commercial contracts. Also: **R. L. Coffey,** manager of product planning analysis and rocket sales; **J. T. Wills,** head of turboprop engine sales. **K. J. Bigelow** succeeds Mr. Wills as manager of the Washington, D. C., Zone Office.

Dr. Ludwig Roth, director of research, Norair Division of Northrop Corp., Beverly Hills, Calif.

Dr. **Wayne Masters,** manager-Antenna Laboratory, Melpar, Inc., Falls Church.

Howard A. Bond, manager of reconnaissance systems, Electronics Division of Stromberg-Carlson, a division of General Dynamics Corp., Rochester, N. Y., and P. **Eugene Laliberte,** director of marketing.

Dr. Robert V. Meghreblian, chief of the Physical Sciences Division, California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif. Also: **Dr. Hadley Ford,** chief, Chemistry Section; **Dr. John Laufer,** chief, Gas Dynamics Section.

Warren F. Westermeier, director of military sales, California Division of Lockheed Aircraft Corp., Burbank, Calif. **J. Fred Lashley** succeeds Mr. Westermeier as military sales manager-Navy.

H. G. Sturgeon, managing director of de Havilland Propellers, Ltd., Hatfield, England, succeeding **Sir Ralph Sorley,** retiring.

Gene Charles, director of sales, and **Tom Sim,** director of marketing, Aero Design & Engineering Co., Bethany, Okla.

Jack G. Roback, general sales manager, Monitor Systems, Inc., Fort Washington, Pa., subsidiary of Epsco, Inc.

C. K. Fulton, sales manager, Missile Defense Equipment, General Electric Co.'s Heavy Military Electronics Department, Syracuse, N. Y.

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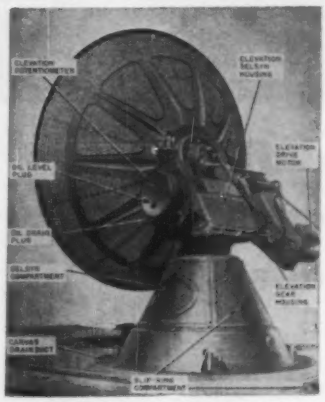

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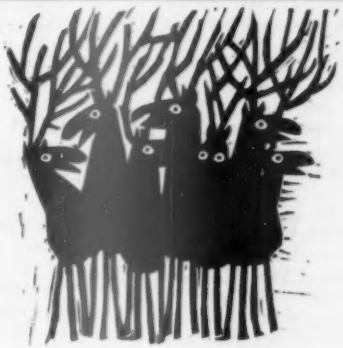

A Solid State Physicist gives a small stag party. He invites his father's brother-in-law, his brother's father-in-law, his father-in-law's brother, and his brother-in-law's father. Find the number of guests.

—adapted from Charles Lutwidge Dodgson

Our Electron Tube Division announces a Broadband Klystron Amplifier Tube capable of providing over 2 megawatts of peak rf power with a 100 megacycle bandwidth at L-band. Inquire if you are doing hard thinking about frequency diversity radar or precisely shaped pulses.

ANSWER TO LAST WEEK'S PROBLEM: The formula for m throws of n dice is (5 mn + 1)

LITTON INDUSTRIES
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LETTERS

First in Space

With Russia having such a reputation for her space exploration "firsts," there's one point I would appreciate being clarified.

The very publicized launching of Lunik I, I understand, was to be the first man-made object to obtain escape velocity. But earlier I had heard reports that on Oct. 16, 1957, an Aerobee research rocket was sent aloft containing about 1,000 steel particles somewhat the size and shape of ball bearings. The particles were kicked free and obtained escape velocity.

Therefore, this would place the United States as being the first to hurtle a man-made object free of the earth's gravity instead of the Soviet Union.

I would certainly appreciate knowing if my assumption is correct.

MICHAEL R. LINDSLEY
St. Louis, Mo.

(Mr. Lindsley is correct. As AVIATION WEEK pointed out when the first Soviet lunar probe was launched (Jan. 12, 1959, p. 28), the U. S. made the first attempt to give escape velocity to man-made particles. Earlier, USAF's Project Farside balloon-launched rockets reached 4,000 mi. altitudes [AW Oct. 28, 1957, p. 31]—Ed.)

Petty Arguing

During the past year I have watched, with much disappointment, what I feel to be a rather sad and unwarranted degrading of the Letters to the Editor page.

I am referring to the sharp and controversial attitude that has developed between the airline pilot and the man who pays the pilot's salary, Mr. John Q. Customer. This attitude has reached the point of petty arguing, and in many cases name calling.

On one side of this controversy we have the man who wears four stripes, sits on the left hand side of the cockpit and who likes to be, and is considered, a "professional man." Surprisingly enough he is many times a man who knows nothing of human and customer relations, and does not fully understand the problems of Mr. J. Q. Customer sitting to the rear of the cockpit door. In some cases he gives little care as to what his problems are, an attitude which should not exist, but does.

On the other side, and to the rear as we mentioned, is the bread and butter of the airline business—the customer. It appears, by recent letters found on this page, that a few, possibly many of these gentlemen, have all of a sudden become airline "experts" to the rear of the cockpit door, and especially forward of this door. I doubt if there is one out of a hundred who knows the difference between a fan marker and an outer marker, or how an emergency window opens. And, the one among the hundred who does, knows enough of the problems of both ends not to become an "expert."

It seems to be quite evident that few pilots know of the problems encountered by Mr. Customer before entering the airplane, and even those encountered after entering and during the trip. And, it is also quite evident that Mr. Customer is quite a distance out of his field when he begins an oration on problems such as working conditions, pay and safety, which occur forward of the traveling section of an airplane.

After watching and reading these various squabbles for the past several years, with an increasing number in the past year, I feel that it is time for the petty arguing to be removed from this page. Reserve this space for those letters which help the airlines—both Mr. John Q. Customer and the employes.

ROLAND D. BAUMANN
Seattle 6, Wash.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Space Lab Costs

In the article on Chance Vought's modular manned space laboratory concept (AW June 13, p. 85) the total program apparent costs should have read $900.8 million rather than $9.8 million as indicated in the article. The cost breakdown in the article was in keeping with the correct $900.8 million figure and, as usual, you did an excellent writing job.

ROBERT H. LUNDBERG
TOM E. DOLAN
Aeronautical Division
Chance Vought Aircraft, Inc.
Dallas, Tex.

Capsule Recovery

I cannot understand why the Air Force is attempting to recover its Discoverer satellites over the Pacific Ocean rather than in the continental United States. If the satellites were recovered over land areas, even if the drag parachute and radio beacon failed, some wreckage could be found for study. As it is, the satellites are lost at sea and no material is available to determine the cause of the mishap.

The argument of avoiding property damage by the falling capsule is invalid. Over the semi-arid regions of the West, damageable property is so thinly distributed that the probability of an object falling at a random position hitting anything is negligible. Even if this should happen a $10,000 damage suit is far less expensive than a million-dollar capsule vanishing. And if the Russians should find the capsule first, the results are even more devastating.

If the Air Force originally felt that recovery at sea was practicable, experience has shown that this is not the case. They should recover future capsules over land areas occupied by friendly powers.

FREDERICK PILCHER
Lawrence, Kan.

Credit for Domes

We enjoy seeing our products in print (AW May 30, p. 96, photo with caption "Air-Supported Domes House Maintenance Facility"), but how about credit where credit is due?

The structure in question was designed and fabricated by Birdair Structures, Inc., in conjunction with the U. S. Army Quartermaster Corps Research & Engineering Command for the U. S. Army Ordnance Corp. The material was Wellington Sears nylon fabric, coated by Sawyer Coated Fabrics Division, Farrington Texol Corp.

The B. F. Goodrich vinyl compound used to coat the fabric is an excellent material, but it seems that their public relations department is even better.

ALVIN C. SMITH, MGR.
Development and Sales
Birdair Structures, Inc.
Buffalo, N. Y.

BMEWS Costs

We read with interest the excellent article titled "First BMEWS Nears Operational Status" in your issue of May 30 (p. 76).

In the interest of accuracy, we would like to call your attention to a questionable statement under the subhead Civilian Personnel on p. 84:

"Total annual operating cost for this site is estimated at $100 million, slightly less than the cost of operating the DEW Line which is carried out by Federal Electric Corp. under USAF contract."

On July 20, 1959, the USAF announced a contractual award in the amount of $42,101,389 for the operation and maintenance of the DEW Line for fiscal year 1960.

I trust that this will bring into perspective the comparison of costs of operations of these two vital defense projects.

J. W. GUILFOYLE
President
Federal Electric Corp.
Paramus, N. J.

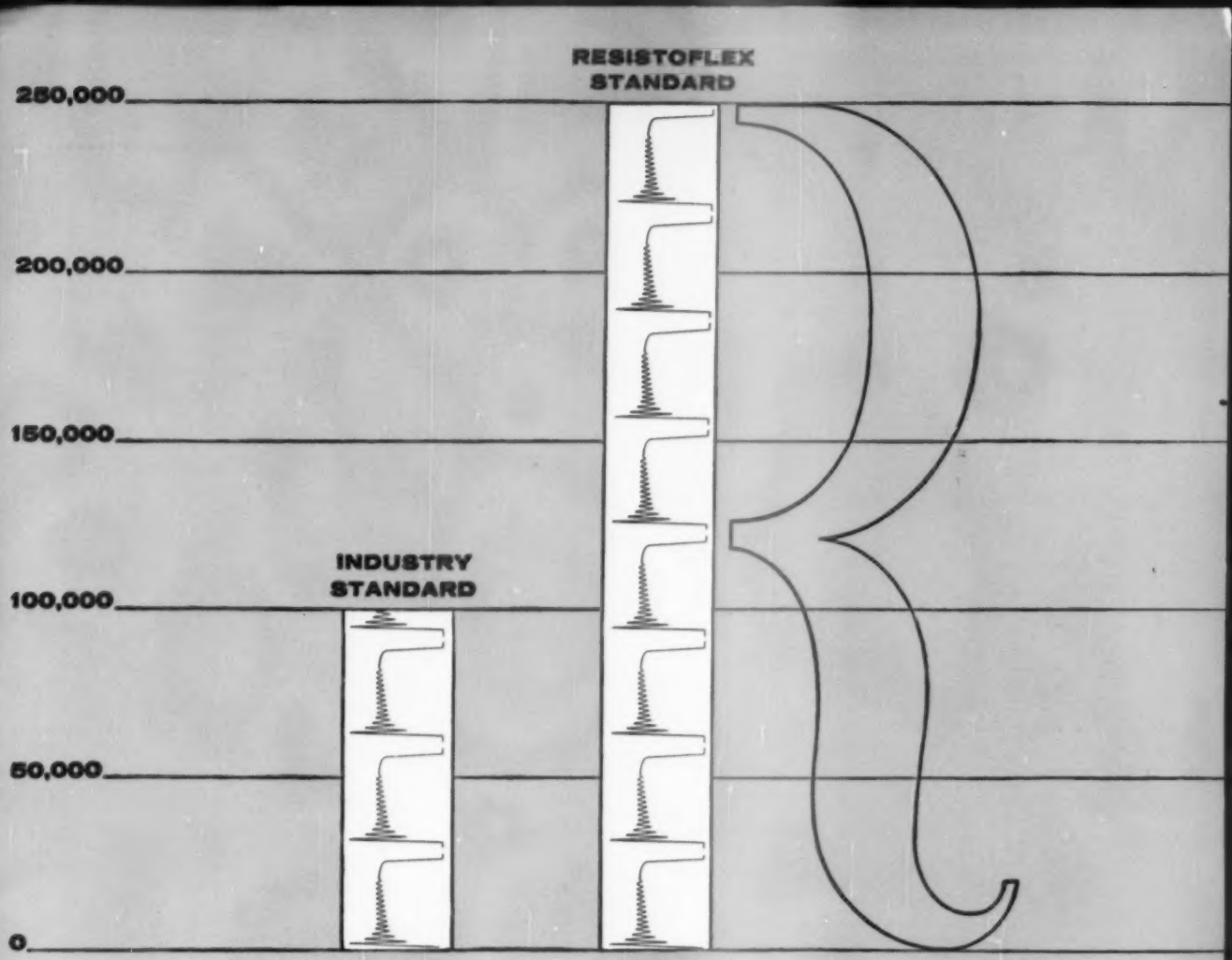
F-104F Cover

The cover picture on the issue of May 30 purports to show "Three of four Lockheed F-104F two-seat jet fighters delivered to West German air force . . . in formation over Germany . . ." I will be willing to eat my particular cover if the scene shown is not the Antelope Valley of California with Lake Rosamond in the background, and I imagine you will also hear from the AV Chamber of Commerce.

Although not always in accord with your editorials, I find that the receipt of AVIATION WEEK is one of the high spots of my week.

CHARLES L. GANDY, JR.
Major, USAF
Montgomery, Ala.

(There is no need for Maj. Gandy to eat his cover; the scene is the Antelope Valley. —Ed.)



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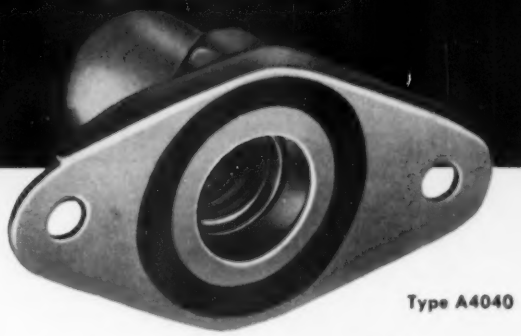
Why this ESNA floating anchor cap seal nut will soon be probing outer space



Type A4040

This Type A4040 floating anchor, base seal, capped nut has been selected to go along on the first manned space flights aboard the National Aeronautics & Space Administration's Astronaut capsule. We can't illustrate this special application as yet, but we can tell you about the unusual performance characteristics of this new design.

Type A4040 is a self-locking anchor nut with a special "O"-ring in the base that provides an hermetic seal to prevent loss of air pressure through seepage along the bolt threads. The stop nut held captive inside the dome provides .020 inch minimum radial floating action to allow quick bolt installation in spite of slight misalignment of bolt holes. It is *100% seal tested* before shipment. The seal is effective whether the bolt is installed or not, and is not destroyed by repeated bolt installations. It will withstand vibration and temperature variations from −70° F. to 400° F.

The A4040 is a typical example of ESNA's willingness to work on the special fastener problems faced by engineers who are designing for the space age.

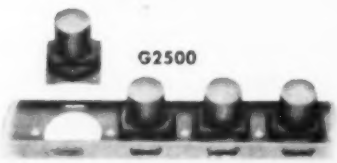
Let us send you complete details on the wide variety of cap seal nuts specifically designed for internal fuel tank fastenings to prevent seepage of volatile fuels: two lug (A2502) and its miniaturized equivalent A2506; one lug (A2507) and straight gang channel strips (G2500). Consider too, the access door design opportunities provided by a football-shaped ring of cap seal nuts such as the one illustrated above and which is performing outstandingly in the integral fuel tanks of one of the nation's newest jet liners.

Write . . . Dept. S54-625, Elastic Stop Nut Corporation, 2330 Vauxhall Road, Union, New Jersey.

A2502

Miniature A2506

A2507



G2500

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